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Diabetes and oral health complications: Australian diabetes health care professionals' knowledge and scope of practice

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Abstract of Thesis

This study assessed Australian diabetes health professionals' knowledge and scope of practice in the area of oral health complications. It described the extent of interventions, health promotion and the driving and restraining forces impacting upon their management of oral health issues in the person living with diabetes.

Using a 28 item web-based questionnaire developed for the study, a descriptive, cross-sectional design was employed to survey 153 members of the Australian Diabetes Society and the Australian Diabetes Educators Association. The data were collected between May 17th and August 22nd, 2010. The categorical and continuous data collected was analysed using the Statistical Package for Social Sciences version 20.

This study found Australian diabetes health professionals do not receive adequate education and training to manage oral health complications within diabetes care. The inclusion of oral health information within the formal curriculum appears inconsistent and confirms a lack of recognition for and impact of oral health complications at a fundamental level. Participants acknowledged the significance of an increased risk of oral health problems in the person living with diabetes, especially for those patients who had more specific management needs, were isolated, or who experienced other diabetes complications. This was strongly associated with an increased level of likelihood to investigate the patients' oral health complaints. Participants' levels of likelihood to recommend treatment options were however, confined to the patients' glycaemic management in the context of the xerostomia condition.

Participants indicated low levels of confidence to undertake an assessment of oral health signs or symptoms, and to provide diabetes related oral health information to patients. Education in oral health complications was found to have a positive impact upon participants' levels of confidence to undertake oral health practices. However, a

proportion of participants indicated they would never undertake an oral assessment as they perceived it was outside of their scope of practice.

The current study data indicated people living with diabetes, who have oral health complications, receive limited support from their diabetes health professionals. This was due to the confines of the current oral health system delivery model. Timely access to appropriate and affordable oral health services for patients was identified as a major barrier affecting management. In addition, a diabetes-specific oral health screening tool and clinical practice guideline were identified as potential factors which would enable improved management of oral health complications in people living with diabetes.

This study has shown Australian diabetes health professionals' knowledge base of oral health complications is limited. It appears there is inadequate education and skill mastery to enable confident assessment, appropriate health promotion, and management of patients' oral health issues within diabetes care. The absence of the clinical practice guideline and diabetes-specific oral health screening tool contributes to this deficit.

Australian diabetes health professionals were cognisant of the increased risk of oral health problems in people living with diabetes, and the need to monitor outcomes for those at greater risk. There is therefore, the potential to change practice behaviours especially in those who have previously believed oral health complication management to be outside of their scope of practice. Overall, within the more specialised area of diabetes management, there is a need for the enhanced provision of diabetes-specific oral health education, clinical resource tools and the delivery of oral health services for people living with diabetes.

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List of Abbreviations

ABS	Australian Bureau of Statistics
ADA	American Diabetes Association
ADEA	Australian Diabetes Educators Association
ADIPS	Australian Diabetes in Pregnancy Society
ADS	Australian Diabetes Society
AGEs	Advanced glycated end-products
AIHW	Australian Institute of Health and Welfare
ANDIAB	Australian National Diabetes Information and Benchmarking
ARCPOH	Australian Research Centre for Population Oral Health
AusDiab	Australian Diabetes, Obesity and Lifestyle Study
BGL	Blood glucose level
CO	Carbon monoxide
DOHA	Australian Department of Health and Ageing
DCCT	Diabetes Control and Complication Trial
DHP	Diabetes Health Professional
FDI	Fédération Dentaire Internationale
GDM	Gestational Diabetes Mellitus
Hb	Haemoglobin
HbA_{1c}	Glycosylated haemoglobin
IDF	International Diabetes Federation
IgG_2	Immunoglobulin G_2
IL	Interleukin
LPS	Lipopolysaccharide
NHANES III	American Third National Health and Nutrition Examination Survey
NHMRC	National Health and Medical Research Council
O_2	Oxygen
OR	Odds ratio
RACGP	Royal Australian College of General Practice
RAGE	Receptor for AGE
SPSS	Statistical Package for Social Sciences
UKPDS	United Kingdom Prospective Diabetes Study
US	United States of America
WHO	World Health Organisation

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Introduction

Background to the Study

Diabetes Mellitus (diabetes) is a chronic endocrine disease the incidence of which is increasing worldwide at an alarming rate. In 2011the prevalence rate was estimated to be between 220-285 million (International Diabetes Federation [IDF], 2011b; World Health Organisation [WHO], 2009). A further seven million people were expected to develop diabetes each year, with the total number of people affected reaching 438 million within the next 20 years (IDF, 2011b). The current estimates indicate that 366 million people are diagnosed with diabetes and the projection for 2030 is expected to reach 552 million (IDF, 2013). A large proportion of this increase will occur in developing countries and may be related to ageing, unhealthy diets coupled with a sedentary lifestyle and increased rate of obesity (Petersen & Ogawa, 2005).

Diabetes is a life-long condition that, without proper management, leads to complications as a result of damage to major organs and tissues especially nerves and blood vessels (IDF, 2011a). There is growing acceptance of seminal research undertaken by the dental profession which indicates diabetes is associated with increased occurrence, extent and severity of oral health problems (Loe, 1993; Safkan-Seppala & Ainamo, 1992; United States [US] Department of Health and Human Services, 2000). These problems include xerostomia and salivary gland dysfunction; susceptibility to bacterial, viral and fungal infections; taste impairment; autoimmune inflammation of the oral soft tissues; nerve dysfunction; dental caries; periapical abscesses; gingivitis; periodontal disease; loss of teeth and an impaired ability to wear dental prosthesis (Vernillo, 2003). The research evidence indicates the bidirectional association between the incidence of periodontal disease and control of blood glucose (US Department of Health and Human Services, 2000). Both diabetes and

periodontitis are thought to share a common pathogenesis, with an enhanced inflammatory response at a local and systemic level, resulting in difficulties in management of either condition when the other is present (Southerland, Taylor & Offenbacher, 2005).

The presence of oral health complications in the individual with diabetes poses additional management requirements that have not always been appreciated by health care professionals. Accordingly, recommendations for care are emerging from the WHO, IDF, the Fédération Dentaire Internationale (FDI; also known as the World Dental Federation) and peak bodies for dental health and diabetes care in the United States, Canada and Europe. These organisations identify the need for initiatives such as heightened surveillance and promotion of oral health care, whilst also calling for multi-disciplinary collaboration to prevent and manage oral health issues in the person with diabetes (IDF, 2008, 2009; Petersen & Ogawa, 2005; Gillis & Saxon, 2003; US Department of Health and Human Services 2003; WHO n.d). There is however, an absence of specific oral health clinical guidelines to direct the health professional to provide evidence-based best-practice care to meet this emerging aspect of diabetes management.

While acknowledgement of the need for improved diabetes and oral health management has begun internationally (IDF, 2005a, 2008), within the Australian health care system it appears to be neither well identified nor managed appropriately. The dearth of recognition of diabetes and oral health complications within the Australian Department of Health and Ageing (DOHA) publications, such as the 'Australian National Diabetes Information and Benchmarking (ANDIAB) Surveys 2004-2009' (2010a), and 'National Service Improvement Framework for Diabetes' (2010e) is evident.

For the majority of people with diabetes, a multidisciplinary health care team provides care. The team care is co-ordinated by the General Practitioner (GP) utilising the 'Guidelines for Diabetes Management in General Practice'. This annually updated Royal Australian College of General Practice [RACGP] publication has, until this year, neglected to include oral health specialists within the team. The primary care guidelines do identify "the need for a full system review checking for vascular, renal, eye, nerve and podiatric problems" (RACGP, 2011, p. 30). However, diabetes related oral health problems are not included within the section that identifies complications. The attention herein, focused upon the issues of macrovascular changes, hypertension, dyslipidaemia, renal and eye damage, foot problems, and neuropathy. While annual oral health screening by an oral health professional is recommended, it does neglects to identify the role that other team members may play in oral health screening and care provided to people living with diabetes.

Based upon the lack of specific guidelines, which encompass oral health complication screening within diabetes management, it would appear that a gap in practice by health professionals specialising in diabetes may be present. As a result the oral health care for people with diabetes is likely to be insufficient. Previous research in oral health care has primarily focused upon the consumers' oral health knowledge, self-care beliefs and efficacy (Allen, Ziada, O'Halloran, Clerehugh & Allen, 2007; Blicher, Joshipura & Eke, 2005; Moore, Orchard, Guggenheimer & Weyant, 2000).

There is an apparent lack of studies investigating the provision of oral health care by diabetes care team members, including those in Australia. More specifically, team members' knowledge of oral health complications and their scope of practice within either the primary or tertiary care context is not known. This is important as health outcomes in the individual with diabetes are not only related to the self-care behaviours enacted, but also the extent and quality of education provision and support

systems (Colagiuri, Girgis, Eigenmann, Gomez, & Griffiths, 2009; Colagiuri, Williamson & Frommer, 1995). These enable uptake and continuation of positive health behaviour change to achieve and maintain optimum health (Australian Diabetes Educators Association [ADEA], 2007). Careful consideration of the diabetes-related oral health burden in light of the projected increase in the prevalence of diabetes within the Australian community is required, as these issues will further challenge the finite service delivery resources. It is therefore imperative that Australia's health care system and health care professionals address any potential deficiencies in care provision to people with diabetes to be able to manage the future demand.

With the limited empirical evidence related to diabetes and oral health complications, a descriptive, cross-sectional study was designed to investigate the current practice of Australian health professionals specialising in diabetes care. In particular to establish what the professionals know about the oral complications, prevention, screening and management. Additionally the driving and restraining factors affecting health professionals' roles in oral health care as part of diabetes management were explored.

This chapter continues with an overview of diabetes, its pathophysiology, major types, incidence and prevalence, the recognised diabetes associated complications, and principles of best practice in diabetes management. The intention is to provide sufficient background to understand the nature of oral health complications and the management that is required from health care professionals as discussed in Chapter 2. Finally the study's purpose and significance are presented.

Context of the problem: Diabetes Mellitus

Diabetes mellitus is a chronic metabolic disorder which is caused by inherited and or acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced, thereby affecting carbohydrate, fat and protein metabolism (WHO, 2002, 2006, 2013). Several processes have been identified in the development of diabetes. These may range from the autoimmune destruction of the insulin producing beta cells of the pancreas resulting in a diminished or complete absence of circulating insulin, to other abnormalities resulting in reduced insulin action within the target tissues of the body known as insulin resistance (American Diabetes Association [ADA], 2004). The changes that occur are linked to the type of diabetes of which several forms exist. Type 1, type 2 and gestational diabetes are the most common.

Diabetes types.

Type 1 diabetes. This form of diabetes occurs due to the cellular-mediated autoimmune destruction of the beta cell of the pancreas. It accounts for 10% to 15% of diagnosed cases of diabetes (Australian Institute of Health and Welfare [AIHW], 2008C, 2010a). Whilst genetic predispositions are identified in the autoimmune destruction, many related environmental factors that are still poorly understood may also be at play. Autoimmune markers are indicative of the physiological changes and one or more of these autoantibodies are usually present in 85% to 90% of individuals when fasting hyperglycaemia is initially detected. This type of diabetes commonly occurs in childhood and adolescence, but it can occur at any age, even in the eighth and ninth decade of life. The insulin production for type 1 is markedly reduced or absent, such that endogenous replacement therapy is required to counteract the consequential rise of blood glucose (ADA, 2004).

Type 2 diabetes. Type 2 diabetes, which accounts for 85% to 90% of diagnosed diabetes cases (AIHW, 2008c, 2010a), is characterised by insulin resistance in muscle, fat and the liver combined with beta cell failure leading to insufficient insulin secretion to compensate for the insulin resistance (Scobie & Samaras, 2010). Insulin resistance refers to the reduced ability of circulating insulin to mediate cellular glucose uptake in the receptors upon the cell surface. In response to this impaired signalling of the receptors, the pancreas hyper-secretes insulin until beta cells fail, leading to the hyperglycaemic state (Scobie & Samaras, 2010).

Insulin resistance, although associated with central obesity, is not present in every person with type 2 diabetes. Other identified factors include genetic mutations within the receptor, the increased circulating levels of fatty acids (from obesity or nutrient excess) causing damage to the beta cells (lipotoxicity), and systemic inflammation which interferes with insulin action (Scobie & Samaras, 2010). Whilst there is a strong genetic predisposition, the risk of developing type 2 diabetes increases with age, obesity, and the lack of physical activity. It is more frequent in women with a prior history of gestational diabetes, in individuals with hypertension and deranged blood fats (dyslipidaemia), and is also recognised to occur at greater rates in certain racial/ethnic groups (ADA, 2004).

Regardless of the cause, Scobie and Samaras (2010) identify reduced insulin secretion and cellular resistance as the pathophysiology for the trademark hyperglycaemia. Management of type 2 diabetes may initially involve a combination of changes, which include a healthy diet, increased exercise and weight loss. When glycaemic control remains suboptimal despite lifestyle changes, oral and injectable antihyperglycaemic agents, and in some cases, insulin replacement is necessary to achieve normal glucose targets for optimum health (IDF, 2005b).

Other specific types of diabetes. The main primary causes of diabetes categorised as 'Other specific types' are pancreatic trauma or disease through inflammation, infection, chemical or drug induction, carcinoma, cystic fibrosis and haemochromatosis. Genetic defects can affect beta cell secretion or insulin receptor function (ADA, 2004), which according to Cochran, Musso and Gorden (2005), "represents a major therapeutic challenge in terms of achieving glycaemic control, having more extreme forms of insulin resistance than typical type 2 diabetic patients" (p. 1240).

Gestational Diabetes (GDM). Gestational diabetes mellitus is defined as any degree of glucose intolerance with onset or first recognition during pregnancy (WHO, 2002, 2013). The incidence of GDM is estimated by the Australasian Diabetes in Pregnancy Society (ADIPS) to be in the vicinity of 5.5% to 8.8% of all pregnancies. Australian Indigenous, Polynesian and South Asian [Indian], Middle Eastern and other Asian groups are at greater risk (Hoffman, Nolan, Wilson, Oats & Simmons, 1998). A later review by the ADIPS identified the data contained within their management guideline remained current (Simmons, Walters, Wein & Cheung, 2002). The AIHW report 'Australia's Health' (2012) further confirms the prevalence rate for GDM remains stable at 5%.

During pregnancy there is reduced insulin sensitivity. This is attributed to increased food intake, increased adiposity and decreased activity levels, along with growth of the foetus and increasing pregnancy hormones which decrease insulin-mediated glucose uptake (Buchanan & Dornhorst, 1996). This, in combination with deficient or poorly-timed insulin release from the pancreas, result in the abnormal increase in blood glucose levels (BGL). Failure of the pancreatic beta cells to meet this increased demand is responsible for the development of gestational diabetes

mellitus (Harmel & Mathur, 2004). Research evidence indicates women with GDM are at greater risk for the development of type 2 diabetes later in life, with their baby also at increased risk for the development of obesity and/or diabetes. GDM adds an intrauterine environmental risk factor to an already increased genetic risk (Hoffman et al., 1998; 2002). Therefore treatment to maintain BGL's within the target range for pregnancy is focused upon a combination of dietary adjustment, oral antihyperglycaemic agents and insulin therapy (WHO, 2002; 2006; 2013).

Irrespective of the type of diabetes, the normal blood glucose variation of 3.5 to 7.8 millimoles per litre is not maintained. The insulin released in response to a postprandial BGL rise is deficient with consequent elevated BGLs (hyperglycaemia) (Baker IDI, 2010b). The resulting hyperglycaemia damages many of the body's systems, in particular the blood vessels and nerves (WHO, 2002), and it is these pathological changes that are more closely aligned with the oral health complications of interest in this study. These issues are discussed next.

Chronic diabetes complications. Chronic hyperglycaemia has traditionally been identified as the major factor associated with the development of long term complications in people with diabetes. Glycosylation, the process of glucose chemically attaching, without the aid of enzymes, to proteins and nucleic acids within tissues was recognised by Brownlee, Vlassara and Cerami (1984) as the common biochemical link between chronic hyperglycaemia and a number of patho-physiological processes involved in complication development. Current research studies continue to focus on the factors identified by Brownlee (1994); those being the interplay of molecular pathways and the influence of insulin resistance and inflammation in complication pathogenesis (Villeneuve & Natarajan, 2010). Complications are broadly categorised into three main areas: those affecting the

macrovascular (large arteries), microvascular (veins and capillaries), and nervous systems, as detailed in Table 1.1.

Table 1.1
Chronic Diabetes Complications

Microvascular	Macrovascular	Nervous
Nephropathy	Hypertension	Acute painful neuropathy
Diabetic foot	Cardiovascular disease	Autonomic neuropathy
Retinopathy	Cerebrovasular disease	Proximal motor neuropathy
Cataracts	Peripheral vascular disease	Diabetic mononeuropathy
Glaucoma	Erectile dysfunction	Chronic insidious sensorimotor neuropathy

(Scobie & Samaras, 2010, pp. 69-93)

It is the duration and extent of hyperglycaemia, often in combination with hypertension and dyslipidaemia, which exacerbates a range of cellular factors within the individual with diabetes that leads to tissue injury and loss of function. Those factors most notably identified are: gene expression for dysfunction and disease, the increased stiffness of artery walls and permeability of the capillary walls, blood coagulation, and the formation and progression of atherosclerotic lesions within blood vessels. This is in addition to the increased permeability of smooth muscle cells, the thickening of the cells' basement membranes and tissue expansion, with the accumulation of advanced glaciated end-products (AGE's) within the peripheral nerves affecting neuronal blood flow and nerve conduction (Meece, 2003; Peppa, Uribarri & Vlassara, 2003). These effects are the major cause of morbidity and mortality in individuals with diabetes in Australia (Bate & Gerums, 2003).

As discussed, it appears that in contrast to complications arising in other body organs and tissue, there remains little recognition of oral health complications. While diabetes health professionals (DHPs) are cognisant of most complications and employ 'best practice' screening and management, it would appear that there is little awareness of oral health complications. Therefore, the current study investigates this issue.

Australian diabetes prevalence and incidence trends. According to the Australian Institute of Health and Welfare (2010), there is limited accurate information available to determine the number of people with each type of diabetes. It states, "most of the statistics refer to 2010 or earlier. This is because some data, such as population-based surveys, are collected every 3–5 years or even less often" (p. xiv). Therefore, based upon the self-reported data within the 'National Health Survey 2004-2005', approximately "700,000 Australians (3.6% of the population) have diabetes, with 13% having type 1 diabetes, 83% have type 2 and a further 4% unable to identify their diabetes type" (Australian Bureau of Statistics [ABS], 2006, p. 10). More recent data from combined databases indicates at least 45,000 new cases each year, excluding gestational diabetes. The latest figure for gestational diabetes, available within the 'National Hospital Data' report, indicates there was "11,000 cases of diagnosed gestational diabetes each year" (AIHW, 2008c, p. 11).

Colagiuri, Borch-Johnsen, Glümer and Vistisen (2005) identify the likelihood of an increasing prevalence of diabetes into the future, describing the potential rise in type 2 diabetes cases as eventuating in a "diabetes epidemic". As a consequence it is expected that diabetes will significantly increase the burden upon the health care system. According to Begg et al. (2007), "diabetes accounted for 5.5% of the total disease burden and the eighth leading cause of disease and injury in Australia in 2003, with type 2 diabetes accounting for 92% of this disease burden, ranking the second in males and fourth in females as the leading cause of disease" (p. 197).

The anticipated increase in diabetes prevalence will place further demands upon health services (Zimmett, 2002), and oral complications will challenge this further. Therefore, it would appear that investigation of the current knowledge of oral health complications and their management by Australian health care professionals who specialise in diabetes care is warranted.

Best-practice management principles for diabetes care. The concern with diabetes primarily relates to the devastating consequences when BGLs are not managed within the evidence-based glycaemic targets. The findings of the Diabetes Control and Complication Trial (DCCT) Research Group (1993) demonstrated that intensive efforts to reduce hyperglycaemia associated with type 1 diabetes decreased the incidence of the major chronic complications by as much as 40% to 75%. Another landmark diabetes study, the 1977-1997 United Kingdom Prospective Diabetes Study (UKPDS), showed a continuous relationship between the risks of microvascular complications and glycaemia in type 2 diabetes, such that for every percentage point decrease in the glycosylated haemoglobin (HbA_1c) e.g. 9% to 8%, there was a 35% reduction in the risk of complications (ADA, 2002). Of note, these studies have not included oral health complications within the range of acute and chronic complications investigated.

The glycosylated haemoglobin test is a measure of blood glucose attachment to the haemoglobin protein contained within the red blood cell. It indicates blood glucose control over the approximate three month life-span of an average red blood cell, and is used as a gold standard in diabetes management worldwide. A recommendation from the Australian Diabetes Society (2009) is for a general target HbA_1c of $\leq$7.0% for most patients. While intensive glycaemic control is identified to be of greatest benefit early in the disease process, a tighter ($\leq$6.0%) or lesser ($\leq$8.0%) target should be based on patient specific factors such as the type and duration of diabetes, the type of diabetes medication being taken, in addition to the risk for and outcomes from hypoglycaemia, the presence of cardiovascular disease, other co-morbidities, and pregnancy. Careful management of glycaemic control through lifestyle changes and pharmacotherapeutics has become the primary strategy for preventing diabetic complications.

The overall aim of management, as described within the 'Guidelines for Diabetes Management in General Practice 2011-2012', is to "improve quality of life and prevent premature death" which includes the "relief of symptoms and acute complications" as well as the "identification and treatment of chronic complications" (RACGP, 2011, p. 16). The guidelines describe evidence-based practice for managing diabetes and its complications; however, they appear insufficient to direct the health professional in the assessment and management of diabetes associated oral health problems that may arise. This is of importance as oral health complications may not only influence the glycaemic control and medical management of diabetes, but also have a far greater impact in diminishing the individual's quality of life. The complications associated with diabetes are identified by Rubin and Peyrot (1999) as "the single most important disease-specific determinant of quality of life" (p. 205). According to Rubin and Peyrot, the psychosocial effort required to manage the daily demands of diabetes is significant and in turn influences self-care behaviours, long-term glycaemic control and risk of complications. Furthermore, research findings consistently show the presence of two or more complications is associated with worsened quality of life.

According to the US Surgeon General's report on oral health in America, oral health is "related to well-being and quality of life" (US Department of Health and Human Services, 2000, p. 146). The consequences of oral health problems have been shown to include limitations in food selection, often with poor nutrition occurring due to the compromised ability to bite, chew and swallow foods. Oral-facial pain is a major cause of sleep deprivation and depression. When combined with other psychosocial factors, limitations in verbal and non-verbal communication, intimacy and social interaction, it impacts upon the individual's self-esteem and further influences their ability to access educational and employment opportunities along with health services. Overall, "reduced oral-health-related quality of life is associated with

poor clinical status and reduced access to care" (US Department of Health and Human Services, 2000, p. 147).

With due accord to what is known about diabetes and oral complications, it is imperative that identification and management of oral health complications occurs as part of the diabetes related care. Furthermore, if the health care team is knowledgeable and skilled in oral health care, their education and promotion of oral health issues as part of diabetes care may enhance "active, constructive coping" by the individual with diabetes (Rubin & Peyrot, 1999, p. 218). In addition, Rubin (2000) states "the quality-of-life issues are crucially important, because they may powerfully predict an individual's capacity to manage his disease and maintain long-term health and well-being" (p. 21), which is ultimately the goal of any health professional involved in diabetes care.

Purpose and rationale for the Study

The purpose of this study was to ascertain the current levels of knowledge and scope of practice amongst Australian DHPs in the prevention, promotion and management of diabetes related oral health complications in the varied patient[1] population that they manage. It describes the practitioners' experiences, practice settings and the patient populations managed in terms of age, types of diabetes identifying those, who due to their circumstances, may be at greater risk and require specialised medical attention.

This study investigates the extent of health professionals' knowledge of oral health complaints, the sources of prior information and whether resources are utilised in the acquisition of further knowledge. It attempts to describe not only the health professionals' likelihood, levels of confidence, frequency, depth and breadth of

[1] *Henceforth the noun patient will be used to denote both patient and client.*

screening for oral health complications in the person living with diabetes, but also the levels of concern if oral health problems are detected. The extent of treatment recommendations provided to the high risk patient to further manage their diabetes and oral health is also explored. Finally, the driving and restraining factors affecting the health care professionals' role in oral health care as part of diabetes management is surveyed.

Study objectives

Specifically the objectives of this study were to:

1. Assess Australian DHPs' levels of knowledge of oral health issues that impact upon the person with diabetes.
2. Determine the DHPs' scope of practice regarding intervention, health promotion and care management of oral health issues in persons with diabetes.
3. Identify the restraining and driving forces that influence the provision of oral health care prevention and intervention for people with diabetes.

Significance of the Study

Health care professionals can have significant input in supporting people with diabetes to self-manage the condition. Australia's health care system appears to be lagging behind in implementing evidence based clinical care and preventative health care activities in diabetes and oral health at both a primary and tertiary level. Given the rising prevalence of diabetes with recognition that diabetes related oral health promotion and care is under serviced, it would therefore appear timely that an Australian study examining current DHPs' levels of knowledge and health promotion activity in clinical practice, may provide a level of evidence to support guideline development. From this there may be an improved level of diabetes care management.

Overview of the thesis

This thesis is presented in five chapters. The first chapter has provided an overview of the diagnosis and classification of diabetes, the pathophysiology of the disease and the pathogenesis of complications associated with diabetes when it is it not well controlled or managed. Literature relevant to the current trends in diabetes incidence, prevalence and management has also been provided. An introduction to the study objectives, purpose and rationale for the study has been included. Chapter 2 discusses the available literature regarding the prevalence and severity of oral health complications as they impact upon the individuals with varied types of diabetes mellitus, the pathogenesis of periodontitis and its relationship to diabetes as well as oral health care management. Chapter 3 discusses the study design, sampling method, measurement tool development and pilot testing phase as well as the data collection and method of analysis employed in the main study. Chapter 4 presents the findings of the study and finally, Chapter 5 discusses the implications of the findings, limitations of this study and makes recommendations in relation to future diabetes and oral health care clinical practice and research.

Chapter 2: Literature Review

This chapter presents an overview of the available evidence of oral health complications associated with diabetes mellitus and focuses upon the major complication of periodontitis, the pathological processes in its development, and its impact upon the health outcomes in the person with diabetes. The literature review details the prevalence rates in the individual with diabetes, as well as investigating the current management practices for oral health complications. In addition, the guidelines for care, and the knowledge and skills base that currently exists for DHPs providing care to people living with diabetes is explored.

Risks for and prevalence of periodontal disease in diabetes

It is well established that individuals with diabetes, compared with non-diabetics, have an increased risk of developing periodontal disease. Additionally they experience more severe and more rapid progression of the disease (Kapellas & Slade, 2008; Loe, 1993; US Department of Health and Human Services, 2000). Furthermore, the risk is independent of whether the diabetes is type 1 or type 2 (Lalla et al., 2006). The increased risk is associated with the duration of the diabetes condition and to it being poorly controlled (Garcia, Henshaw & Krall, 2001; Loe, 1993; Tsia, Hayes & Taylor, 2002; US Department of Health and Human Services, 2000). This appears an important factor with studies showing more advanced periodontitis with tooth attachment loss when the individual has had diabetes for more than 10 years, rather than aged matched individuals without diabetes (Glavind, Lund & Loe, 1968; see also Hugoson, Thorstensson, Falk & Kuylenstierna, 1989, as cited in Ryan, Carnu, & Kamer, 2003). In addition a greater prevalence is confirmed in individuals with diabetes who also experience other complications of diabetes, e.g., retinopathy,

nephropathy and cardiovascular disease (Southerland, Taylor, Moss, Beck & Offenbacher, 2006).

Multiple dental studies have shown diabetes doubles the risk of severe periodontitis (Tsai, Hayes & Taylor, 2002; Khader, Dauod, El-Qaderi, Alkafajei & Batayha, 2006), and doubles the rate of periodontal disease progression (Yalda, Offenbacher & Collins, 1994). In a study by Lalla et al. (2007), children and adolescents (n = 300) with diabetes, being free from diabetes complications (6-18 years), in comparison to those without diabetes (n = 300), after adjusting for confounding variables, showed greater prevalence of gingival inflammation and periodontal disease (mean odds ratio 2.96). Furthermore, their Mean HbA_{1C} results from the preceding 2 years (8.49% +/- 1.74) were associated with the periodontal destruction (odds ratio, 1.31; 95 % confidence interval, 1.03-1.66; $P < .03$). The results were the first to demonstrate the association between diabetes and an increased risk for periodontal destruction very early in life.

Analysis of data collected in 'Australia's 'Dental Generations: National Survey of Adult Oral Health 2004-06' showed age was strongly associated with the greater evidence of plaque and almost double the degree of gingival inflammation in diabetic adults (greater than 15 years, 4% of the 4967 individuals examined) in comparison to the non-diabetic participants. The results, despite adjustment for age, remained statistically significant. Within the 35 to 64 year age group, the destruction seen at multiple sites within the periodontal tissue of the diabetic participants were elevated at least two-fold over that seen in the non-diabetics. The researchers considered this as an important indicator of poor prognosis for subsequent tooth loss (Kapellas and Slade, 2008).

These studies highlight the need for both glycaemic control and surveillance of the periodontal condition in children. This need also exists in individuals in the fourth

decade of life. This age period is the most common for not only diagnosis of chronic periodontitis, but also type 2 diabetes, especially in women with a history of GDM (Australian Research Centre for Population Oral Health [ARCPOH], n.d.a).

According to Salvi, Lawrence, Offenbacher and Beck (1997), in their review "cross-sectional, case-history, case-control and longitudinal studies indicated diabetes was indeed a risk factor for periodontal disease with odds ratios in the order of 2 to 3 for diabetics as compared with non-diabetics" (p. 179). Furthermore, they identify multiple factors which impact upon an individual, adjusting their level of risk, stating the "reported oral health differences between type 1 and type 2 diabetic patients may relate to differences in glycaemic control strategies, age of onset and duration of the disease...which determines the duration of the hyperglycaemic challenge...and the individual periodontal disease susceptibility" (p. 179).

In addition, the strategies employed in diabetes care are important factors in prevention of oral health complications. The data from the American Third National Health and Nutrition Examination Survey (NHANES III, 1988-1994) showed the chances of having severe periodontal disease when HbA_{1C} was suboptimal is approximately 50% higher than the unaffected population (Tsai, Hayes & Taylor, 2002). While periodontitis is now recognised as a complication of diabetes, Hirsch (2004) reports an increased risk does not exist in people with well-controlled diabetes who have good oral hygiene practices; however, those individuals that have poorly controlled diabetes, poor oral hygiene practices and who are also smokers are significantly susceptible to periodontal disease.

In Australia in 2004–05, there were 300 hospitalisations for people with diabetes with periodontal complications, with an average stay of three to seven days (AIHW, 2000b, 2008d). While hospital admission data were collected, dental surgery visits by people with diabetes and those who required, yet who were unable to access dental

services, was not recorded. Therefore there is no way of determining the prevalence of oral complications among people with diabetes, or being able to compare this to the prevalence figures for other diabetes complications in this period. These complications were identified as neuropathy 5%, peripheral vascular disease 4%, and diabetic foot 3%, with the remaining 78 % attributed to loss of 'health life years' and premature death related to ischaemic heart disease, stroke and disability (AIHW, 2008a, 2008d, 2008e).

Diabetes and oral health complications.

There is a diverse range of oral health complications reported in people with diabetes. While some may appear relatively minor, others can be extensive, severe and therefore devastating in their impact upon the health and well-being of the person affected (Vernillo, 2003). The following section explains the nature of the oral health complications identified to date.

Xerostomia. Xerostomia is identified by Crockett (1993) as "dryness of the oral mucosa of varying severity and a reduced flow in saliva" (p. 114). Schifter (1999) further explains it as "a symptom and does not itself represent a pathological entity" (p. 17). Diabetes can lead to a marked dysfunction of the secretory capacity of the salivary glands and may be related to dehydration secondary to hyperglycaemia (Taylor et al., 1998; Vernillo, 2003). A study by Russotto (1981) found xerostomia to be associated with an asymptomatic, non-inflammatory, non-neoplastic enlargement of the parotid gland. It occurred in 25% of the 400 participants with diabetes, especially those with type 1 and with poor metabolic control. While the exact aetiology is unknown, it is thought to be related to decreased insulin production, the autoimmune

diseases mumps, and Sjögren's Syndrome (Loe & Genco, 2000; US Department of Health and Human Services, 2000).

Xerostomia is a common side effect of oral medications. While the mechanisms are not well identified, it is understood that up to 400 medications in the classes of anticholinergics, antihypertensives, antidepressives, oral antihyperglycaemic agents and many analgesics drugs have been identified as causing xerostomia (Schifter, 1999). In the elderly, multiple classes of medications are frequently used in combination. The aging process itself is associated with not only the decreased function of the salivary glands (Schifter, 1999), but also a greater proportion of denture use. Xerostomia is also exacerbated by activities such as hyperventilation, mouth breathing, smoking and drinking alcohol (Southerland, Taylor & Offenbacher, 2005).

Individuals with xerostomia experience problems with speaking, chewing and swallowing, with the tongue frequently sticking to the palate. The wearing of dentures may be problematic, in particular denture retention with reports of denture sores being common. Individuals experiencing xerostomia may find oral care activities, such as brushing and flossing, painful. As a result, the reduction in oral hygiene practices leads to increased gingival inflammation (Jahn, 2004). Further complaints of taste disorders (dysgeusia), a painful tongue (glossodynia), and an increased need to drink water at night are also common (Southerland, Taylor & Offenbacher, 2005). Therefore the problems with chewing and swallowing, taste disturbance, salivary flow, inflammation and pain, experienced by the individual with diabetes, negatively impacts upon their dietary choices and oral hygiene practices, thus placing them at even greater risk for poorer metabolic control and oral health status (Vernillo, 2003).

Increased rates of dental caries are observed in association with xerostomia due to the reduced volume of salivary enzymes, which is the primary defence to bacteria within the mouth. The saliva functions to buffer the acids produced by cariogenic

bacterial species, as well as providing an essential re-mineralisation process which repairs the non-cavitated carious lesions; thereby preventing further dental decay (Schifter, 1999; US Department of Health and Human Services, 2000). If the development of dental caries is left untreated, they can result in an infection of the dental pulp and resultant tooth abscess. The onset of caries requires *Streptococci mutans* bacteria (Jahn, 2004; Southerland, Taylor & Offenbacher, 2005). Studies show this bacterial species attaches well to the tooth surface and produces acids from sugars more readily than other bacteria species. Thus the combination of a dry mouth and a greater source of glucose within the saliva of people with diabetes may lead to a higher dental caries risk (Southerland, Taylor & Offenbacher, 2005). In addition, a greater incidence and prevalence of problems such as parotid gland enlargement, inflammation, cracking and fissuring of the lips (chelitis), tongue and buccal mucosa with subsequent ulceration, oral candidiasis, salivary gland infection (siladenitis) and halitosis occurs when xerostomia is present (Southerland, Taylor & Offenbacher, 2005; Vernillo, 2003).

Candidiasis. Oral candida is a fungal infection caused by *Candida albicans* (US Department of Health and Human Services, 2000). The infection is typically visualised as white or yellow spots or a film upon the tissues of the mouth. Brushing reveals ulcerated areas that are tender and may bleed (Gutkowski, 2008). Candida, contained within the normal flora of the mouth, usually over-colonises to cause infection as a side effect of taking medications such as antibiotics, antihistamines and chemotherapy drugs. It is associated with the development of salivary dysfunction in xerostomia, salivary hyperglycaemia in diabetes, and the compromised immune system seen in drug abuse, malnutrition, old age and in immune deficiency disorders (D'Aiuto & Massi-Benedetti, 2008; Southerland, Taylor & Offenbacher, 2005; Vernillo, 2003).

Studies have shown significantly higher prevalence of candida in people with diabetes versus those without (Fisher, Lamey, Samaranayake, Macfarlane & Frier, 1987; see also Geerlings & Hoepelman, 1999, as cited in Southerland, Taylor & Offenbacher, 2005). Candida infections are common in people who wear dentures and in those who smoke (Guggenheimer et al., 2000, as cited in Ship, 2003). Frequently ill-fitting dentures cause breaks in the mucosal membranes at the corners of the mouth that provide a site for candidal growth (Southerland, Taylor & Offenbacher, 2005).

Lichen planus. Oral lichen planus is a chronic inflammatory disease that appears as bilateral white striations, papules or plaques on the buccal mucosa, tongue, and gingivae. Erythema, erosions and blisters may or may not be present (D'Aiuto & Massi-Benedetti, 2008; Southerland, Taylor & Offenbacher, 2005). While the pathogenesis is unknown, studies indicate that lichen planus is a T-cell mediated autoimmune disease in which 'cytotoxic' ($CD4^+$ and $CD8^+$) lymphocytic T-Cells trigger the apoptosis (programmed cell death) of epithelial cells within the oral cavity. The individual experiences mucosal erythema, ulceration, pain and sensitivity (Lodi et al., 2005; Thornhill, 2001; Vernillo, 2003). Lichen planus may predispose the individual to an increased risk of oral cancer (D'Aiuto & Massi-Benedetti, 2008) and infection by *Candida albicans* (Southerland, Taylor & Offenbacher, 2005).

While previous studies have been unsuccessful in identifying the relationship between lichen planus and diabetes, Lundstrom (1983), in a study of 40 patients with oral lichen planus and 40 patients without, found "28% of patients with lichen planus had diabetes compared to zero in the control group, indicating that diabetes may be related to the immunopathogenesis of lichen planus" (p. 147). In a report by Ship (2003), the association of lichen planus in people with diabetes is explained as, "In patients with type 1 diabetes, chronic immune-suppression is most likely a sequelae:

however, in type 2 patients, it is the acute hyperglycaemia causing alterations to the immune responsiveness" (p. 85).

Burning mouth syndrome. Burning mouth syndrome is a chronic pain condition associated with tingling, numbness and burning sensations of the tongue, lips and mucosal regions of the mouth. The patient reports it in the absence of clinically detectable lesions (Vernillo, 2003). The pathophysiology is mainly idiopathic but is associated with poorly controlled diabetes, hormone therapy, psychological disorder, neuropathy, xerostomia and candidiasis (Rhodus, Carlson & Miller, 2003; see also Scala, Checchi, Montevecchi, Marini, & Giamberardino, 2003, as cited by Southerland, Taylor & Offenbacher, 2005).

In Australia, according to data from the Australian Diabetes, Obesity and Lifestyle Study (AusDiab 1999–2000) (Baker IDI, 2010a), the prevalence of clinically diagnosed signs of diabetes-associated neuropathy was "10.3% for males and 8.6% for females" (AIHW, 2008b, p. 43). Strict glycaemic control is reported by the AIHW, (2008b) as having "been shown to reduce or prevent the development of neuropathy, and may alleviate neuropathic symptoms" (p. 43). This is also identified by Vernillo (2003), as having an impact by "reducing the occurrence of associated oral complications; xerostomia, candidiasis, and therefore contribute more substantially to the resolution of the symptoms of burning mouth syndrome" (p. 27s).

Gingivitis. Gingivitis is a common inflammation of the gingival tissues in response to the formation of the soft, colourless, sticky film of bacteria known as plaque biofilm, upon the teeth and gums (Southerland, Taylor & Offenbacher, 2005). Gingivitis may also occur in women who are pregnant as a result of the hormonal changes upon the gingival tissues and their exaggerated inflammatory response to

plaque. This usually develops after the second month, reaching a peak at the eight month of gestation and usually resolves following the birth of the baby (Coventry, Griffiths, Scully & Tonetti, 2000; McGraw, 2002 as cited in the American Academy of Pediatric Dentistry, 2007).

The signs and symptoms of gingivitis include red, swollen, tender gums that may bleed when brushing teeth. The person may or may not notice an associated halitosis (bad breath) or a bad taste in the mouth. Necrotic ulcerated gum tissue commonly occurs at its margin with the teeth, with the gum tissue receding from the root surface, giving an elongated appearance to the tooth; exposing the tooth portion that is without dentin (enamel), to the oral environment and thus, to a greater risk for decay (Southerland, Taylor & Offenbacher, 2005), refer to figure 2.1.

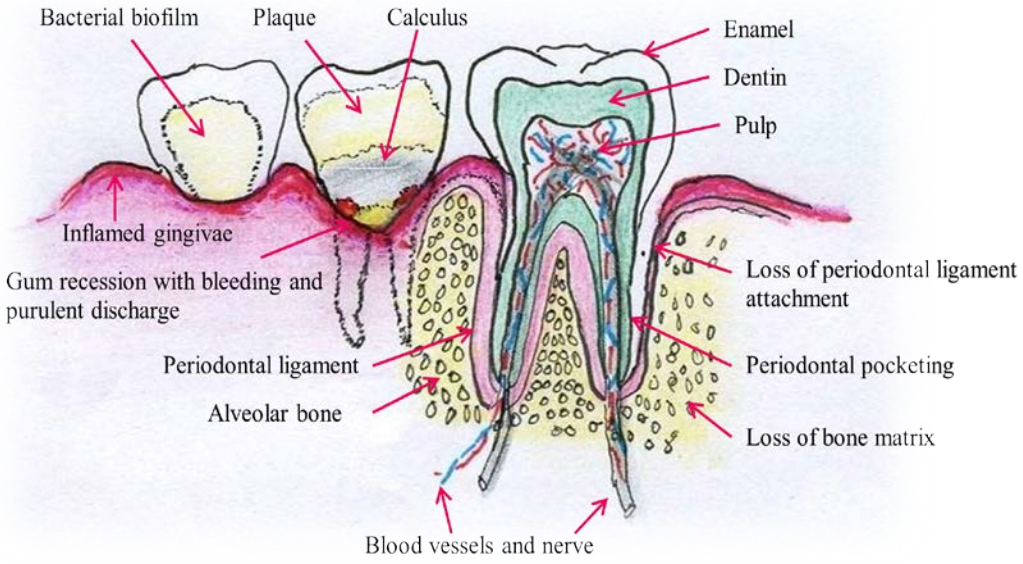

Figure 2.1 Anatomical representation of oral health problems occurring within the gingival and periodontal tissues of the oral cavity.

When gingivitis is left untreated it progresses to advanced periodontal disease (ARCPOH, n.d.b). Hirsch (2004) states, “while it may precede periodontitis, gingivitis does not inevitably progress to periodontitis” (p. 36). Good daily oral hygiene

practices, such as brushing, flossing and antibacterial mouthwash along with regular dental visits to remove the plaque deposits have been shown to prevent periodontal disease progression (ARCPOH, n.d.b; Little, Falace, Miller & Rhodus, 2002).

In the person with diabetes, especially those who have poor metabolic control, the gingival crevicular fluid sourced from the soft tissue pocket adjacent to the tooth surface, may present increased concentrations of glucose (D'Aiuto & Massi-Benedetti, 2008; Vernillo, 2003). This provides an environment that favours selective growth of pathogenic sub-gingival bacteria while also adversely affecting the individual's immune defence against infection in the periodontal tissues (Hallmon & Mealey, 1992).

Incidence rates of gingivitis in children and adolescents with type 1 diabetes have been shown to be nearly twice that observed in populations of children and adolescents without diabetes (De Pommereau, Dargent-Pare, Robert & Brion et al., 1992). A study by Lalla et al. (2006) reported "children with diabetes also had significantly more plaque (plaque index 1.2 vs. 1.1, respectively; unadjusted $P < 0.001$) and gingival inflammation (gingival index 1.2 vs. 1.0 and percentage of sites that bled upon examination: 23.6 vs. 10.2%, respectively) than control children" (p. 298). This had also been observed by Gustberti, Syed, Bacon, Grossman and Loesche (1983), who identified in their study that children before puberty, with "high" levels of glycosylated haemoglobin (>10%), also had higher gingivitis levels than children with "normal" metabolic control of diabetes. They noted that during puberty, the level of gingivitis increased independently from both the fasting BGLs and glycosylated haemoglobin percentage, with a specific shift to predominately anaerobic bacteria in the composition of marginal plaque. They attributed this as a response to host changes within the child at this age period.

In adults with type 2 diabetes, it is generally accepted that the higher rates of gingival inflammation seen in these individuals, as opposed to those without diabetes, is more strongly correlated with the degree of metabolic control (Ryan, Carnu & Kamer, 2003). This indicated the more severe gingival inflammation was detected as glycosylated haemoglobin levels increased.

Periodontitis. According to Loe (1993), "periodontal disease is a chronic inflammatory condition of the periodontal tissues that results in a loss of connective tissue attachment, destruction of alveolar bone, and formation of pathological pockets around the diseased teeth." Loe goes further to identify it as "the most common oral complication of diabetes" (p. 330).

As identified, when gingivitis is left untreated it progresses to more advanced periodontal disease. In the person with poor oral hygiene, plaque overgrowth and maturation occurs causing detachment of gingival tissue from the tooth surface. This facilitates the infiltration into the sub-gingival tissues of anaerobic or facultative gram-negative organisms, notably **"***Porphyromonas gingivalis, Bacteroides forsythus* and *Actinobacillus actinomycetemcomitans,* all have virulence traits that enable these bacteria to evade host clearance via the antibody-complement/neutrophil axis" (Salvi, Lawrence, Offenbacher & Beck, 1997, p. 174). This is further explained by Salvi et al. (1997) as the "bacterial organisms' ability to evade destruction by the neutrophil or that the host neutrophil itself must be dysfunctional for the pathogen to invade deeper into the periodontal tissue for the gingivitis to progress onto periodontitis" (p. 174). Neutrophils are the primary defence cells of the periodontium, thus the reduced neutrophil function observed in individuals with diabetes is yet another mechanism increasing the susceptibility to periodontitis (Hirsch, 2004). The sub-gingival bacteria also promote formation of calculus as a protective mechanism that serves to neutralize

toxic substances. The calculus is thought to be "associated with disease as a surrogate marker for high numbers of metabolically active sub-gingival bacteria, especially black-pigmented species (Salvi et al., 1997, p. 181).

With the escalation in inflammation and bacterial penetration into the deeper tissue, destruction of the connective tissue and alveolar bone supporting the teeth occurs. This results in 'pocket formation' around the teeth, increased occurrences of bleeding from the gingival tissue, eventual destruction of the ligament attachments along with alveolar bone resorption culminating in the loss of teeth (Hallmon & Mealey, 1992; Salvi et al., 1997).

Pathogenesis of periodontitis in diabetes

Both diabetes and periodontitis are thought to share a common pathogenesis. An enhanced inflammatory response at local and systemic levels exacerbates the bidirectional predisposition for complication development (Southerland, Taylor & Offenbacher, 2005). Studies (e.g., Engebretson et al., 2004; Iacopino, 2001; Kurtis, Develioglu, Taner, Balos & Tekin, 1999) have proposed an inter-relationship of mechanisms in the development of periodontal disease in the person with diabetes. These involve 1) altered sub-gingival flora, 2) non-enzymatic glycation, 3) changes in components of gingival crevicular fluid, 4) an altered host response, 5) changes in collagen metabolism, 6) micro-vascular disease, and 7) genetic predisposition (Southerland, Taylor & Offenbacher, 2005). A model of periodontal disease pathogenesis by the American Academy of Periodontology (1999) indicates 'critical nodes' in bacterial aetiology and components of the host response that determine the outcome; either control or remission of the disease, or further cyclical progression in disease severity which is additionally influenced by risk factors such as cigarette

smoking. An explanation of the most significant elements for periodontal disease in the person with diabetes is detailed further.

Advanced glycation end products (AGE's). AGE's are a "class of non-enzymatically glycated proteins and lipids found in plasma, vessel walls and tissues" (Salvi et al., p. 181). Accumulation during the aging process is normal; however, an accelerated rate in the presence of elevated glucose levels occurs (Salvi et al., 2007). According to Peppa, Uribarri and Vlassara (2003) "a large body of evidence suggests that AGEs are important pathogenetic mediators of almost all diabetes complications, conventionally grouped into micro- or macroangiopathies" (p. 186).

AGEs bind to the specific cellular receptor known as the 'receptor for AGE' (RAGE). These are found upon endothelial cells, which line the lumen of blood vessels, and upon the bone marrow derived white blood cell, the monocyte. Monocytes are immature macrophages that migrate to a site of inflammation (such as periodontitis) to destroy and consume pathogens and cellular debris (Cytokines & Cells Online Pathfinder Encyclopaedia [COPE], 2010). The AGE receptor site binding initiates a pro-inflammatory cycle of events, with studies showing receptor site binding upon endothelial cells in particular attracts monocytes to the luminal surface of the endothelial cells under the influence of vascular cell adhesion molecule-1 (Lamster, Lalla, Borgnakke & Taylor, 2008). In addition, the influence of AGE's upon the monocytes is the release of pro-inflammatory cytokines (tumour necrosis factor-alpha, interleukin1-beta, interleukin 6 and prostaglandin E_2) in a poorly controlled manner (Salvi et al., 1997; Southerland, Taylor, & Offenbacher, 2005). Cytokines are a diverse group of soluble proteins and peptides that regulate the function of individual cells, mediating not only the interactions between cells, but also regulating processes

that take place in the extracellular environment in both normal and pathological conditions (COPE, 2008a).

The accumulation of AGE's within the periodontal tissue, along with an increased expression of various genes regulated by the cytokine; transcription nuclear factor-κB (NF-κB) plays a primary role in the expression and severity of periodontal disease, with diabetes and smoking having further adverse modification at a number of levels in the pathogenic pathway (Kirstein et al., 1990; Salvi et al., 1997).

Bacterial biofilm: a crucial factor in periodontal pathogenicity. A diverse bacterial community is found upon the stratified squamous mucosa, teeth and at the muco-gingival margins within the oral cavity (Marsh and Bradshaw, 1995). A clean tooth surface comes into contact with not only bacteria, but also positively charged proteins and glycoproteins, and products from the gingival crevicular fluid within the sub-gingival spaces. These are absorbed into the negatively charged tooth surface to make a layer of conditioning film, called the 'acquired enamel pellicle' (Marsh and Bradshaw, 1995; Seneviratne, Zhange and Samaranayake, 2011).

The primary bacterial colonisers within this pellicle are either aerobic or facultative aerobes such as *Streptococcus* and *Fusobacterium* species. These develop reversible short-range 'van der Waals bonds' through use of their cell surface adhesion molecules to develop stronger irreversible short-range attachments to the teeth. With the subsequent reduction in available oxygen, Gram-negative bacteria; *Actinomyces* species, use protein-protein or carbohydrate-protein (lectin) interactions to co-attach to receptors upon the primary colonisers. Co-aggregation of Gram-negative to Gram-positive species have been also been shown to occur in this manner (Seneviratne, Zhange and Samaranayake, 2011). According to Marsh & Bradshaw (1995), this process contributes to determining the pattern of bacterial succession. At

this stage in the biofilm development, bacterial colonies secrete extracellular polymeric substances which provide a three-dimensional scaffold structure (Seneviratne, Zhange and Samaranayake, 2011). According to Overman (2011) the biofilm matrix contains channels through which nutrients, oxygen, enzymes, metabolites and waste-products can flow to meet the need of the micro-colonies contained; those being differing pH levels, nutrient availability and oxygen concentrations. Furthermore, chemical signalling known as 'quorum sensing, communicates the need between the micro-colonies and enables the bacteria to evade the host defenses, and provides a protective barrier against destruction by antimicrobial agents.

Finally, Seneviratne, Zhange and Samaranayake, (2011) identify the maturation of the biofilm favours tertiary colonisation by Gram-Negative anaerobes mainly *Porphyromonas gingivalis* and *Aggregaribacter actinomyetemcomitans.* It is generally assumed to have occurred after 72 hours, yet individual differences in the rate and thickness of dental plaque formation is dependent upon the dietary intake and host immunity. However, once established is considered to be in a homeostatic state, with drastic changes in diet or host immunity believed to initiate the pathological sequelae of infection into the sub-gingival tissues, evading the concurrent host inflammatory response and representing a shift from a healthy to pathological biofilm which results in the progression to periodontal disease.

Altered connective tissue (Collagen) metabolism. According to Graves, Liu, Alikhani, Al-Mashat and Trackman (2006) the robust inflammatory response seen in individuals with diabetes contributes to the periodontal tissue destruction. The gingival tissue, periodontal ligament and alveolar bone is predominately comprised of type I collagen (Lindhe & Karring, as cited in Salvi et al., 1997), with type IV collagen

found in the basement membrane of blood vessels (Salvi et al., 1997). The hyperglycaemia and AGE accumulation in collagen results in increased thickness and rigidity of blood vessel walls thereby impairing migration of white blood cells in response to inflammation with reduced oxygen diffusion and metabolic waste removal from the site of infection (Salvi et al., 1997). Thus the interaction of AGEs with their receptors has been shown to have a crucial role in the development of microvascular damage within the periodontal tissues (Salvi et al., 1997).

Furthermore, Graves et al. (2006) identify the formation of reactive oxygen species with elevated levels of AGEs and cytokines in the periodontal tissues of people with diabetes. These have the potential to affect the response to bacteria induced periodontitis and oral healing. This occurs as a result of not only the inhibition of collagen production by the osteoblastic and fibroblastic cells within the gingivae and skin, but also through promotion of inflammation and enhanced apoptosis. This enhanced process of apoptosis, the sequence of programmed events leading to cell death of the matrix-producing cells, is also strongly implicated in development of neuropathic, nephropathic and cardiovascular complications seen in the person with diabetes (Huang et al., 2001; see also Yamagishi et al., 2002 and Kaji et al., 2003, as cited in Graves et al., 2006).

The altered host response to periodontal infection. Often the severity and progression of periodontitis in the person with diabetes does not correlate with the bacterial burden observed in the clinical environment. It is believed that the hyper-responsive inflammatory state during the bacterial challenge presented in periodontitis, is associated with the individual's 'host response'. Not only is this determined by genetic regulation of the antibody/antigen response, but also related to the release of

cytokines and the magnitude of their effect in tissue destruction (Rituparna & Neeraj, 2007; Salvi et al., 1997; Southerland et al., 2006).

According to Salvi et al. (1997) and Southerland, Taylor and Offenbacher (2005) multiple studies have shown the levels of inflammatory mediators are significantly higher in periodontitis if the person has diabetes when compared to those without diabetes. The elevated levels of cytokines found in the gingival crevicular fluid of people with diabetes and periodontitis have been shown to influence the metabolism of fibroblasts and lymphocytes causing destruction of collagen and glycoprotein in the connective tissues with subsequent impairment of wound healing. Prostaglandin E_2 inhibits the production of antibodies by plasma cells at the site of inflammation. This adversely influences the body's ability to fight, at the earliest opportunity, the bacterial invasion into periodontal tissues, which results in resorption of alveolar bone and tooth loss (Graves et al., 2006; Hirsch, 2004; Salvi et al., 1997). According to Southerland et al. (2006), the interleukin (IL)-1β, tumour necrosis factor-α, and IL-6, furthermore blocks the activity of the enzyme, lipoprotein lipase. This leads to decreased transportation of lipids from the circulation into the cells, resulting in the clinically elevated low-density lipoprotein and total cholesterol levels, frequently seen in the person with diabetes. The tumour necrosis factor-α, and IL-1β promote glycogenolysis and induces insulin resistance by blocking the insulin receptor tyrosine kinase and other signalling proteins, causing impaired glucose uptake. Therefore a periodontal infection presents a significant metabolic stressor and demand for insulin secretion in the person with diabetes, resulting in further elevation of the individual's blood glucose and lipid levels (Southerland et al., 2006).

The increased susceptibility to periodontal disease in diabetes is also considered to be associated with an impaired neutrophil function. The neutrophil, a bone marrow derived white blood cell, produces superoxide and microbiocidal proteins to ingest

pathogens, cell debris and defective host cells; which are mainly blood cells. This process, known as phagocytosis, plays an important role in mounting the initial host defence against acute and chronic inflammation (COPE, 2008b).

Bacterial products, such as the endotoxin lipopolysaccharide, are thought to propagate the inflammatory response through Toll-like proteins receptors and induce the inflammatory cascade which ultimately contributes to tissue destruction (Wittebole et al., 2005). These receptors have been shown to play an important role in the innate immune response, especially between an infecting microorganism *Porphyromonas gingivalis* and monocytes (Kirschning, Wesche, Ayers & Rothe, 1998), and may be regulated by gene expression influencing the extent of the up-regulated inflammatory response (Salvi et al., 2007). Lipopolysaccharide in the periodontal tissue is believed to alter the neutrophils' 'oxidative burst capacity' thereby impairing phagocytosis of the invading pathogen (Salvi et al., 2007). Thus the oral pathogens and their products have ready access into the systemic circulation aided by an accentuated inflammatory response. Here they are able to further disrupt the body's homeostasis with major impact.

The systemically elevated levels of lipids, especially low-density lipoproteins, triglycerides and unsaturated fatty acids, hallmarks of the metabolic syndrome frequently observed in diabetic individuals, is thought to exaggerate monocyte function and impair the neutrophils' phagocytotic function (Ryan, Carnu, & Kamer, 2003; Salvi et al, 1997). The adipocyte, the major storage site for triglycerides formed from circulating fatty acids, produces large quantities of cytokines in the presence of inflammation (Hotamisligil, Shargill & Spiegelman, 1993; Sniderman & Durrington, 2010). From animal studies, it is thought that the increased inflammatory-stimulated cytokine release contributes to not only insulin resistance, but also further beta cell destruction (Southerland, Taylor & Offenbacher, 2005).

According to Ryan, Carnu, and Kamer (2003), the monocytes, having being exposed to elevated serum lipids and the endotoxin challenge presented by periodontitis, expresses “an inflammatory phenotype rather than a reparative or proliferative one” (p. 38S). Furthermore, macrophages internalise low density lipoproteins from tissue fluids and these are absorbed into the endothelial wall of the artery leading not only to activation and release of cytokines but also foam cell formation which is associated with the increased morbidity and mortality of coronary artery disease (Rituparna & Neeraj, 2007; Southerland et al., 2006). Southerland et al. (2006) go further to state “the combined effect of chronic periodontitis and diabetes could potentially constitute an even greater risk for developing sub-clinical coronary artery disease than would be predicted by either diabetes or periodontal disease alone” (p. 137).

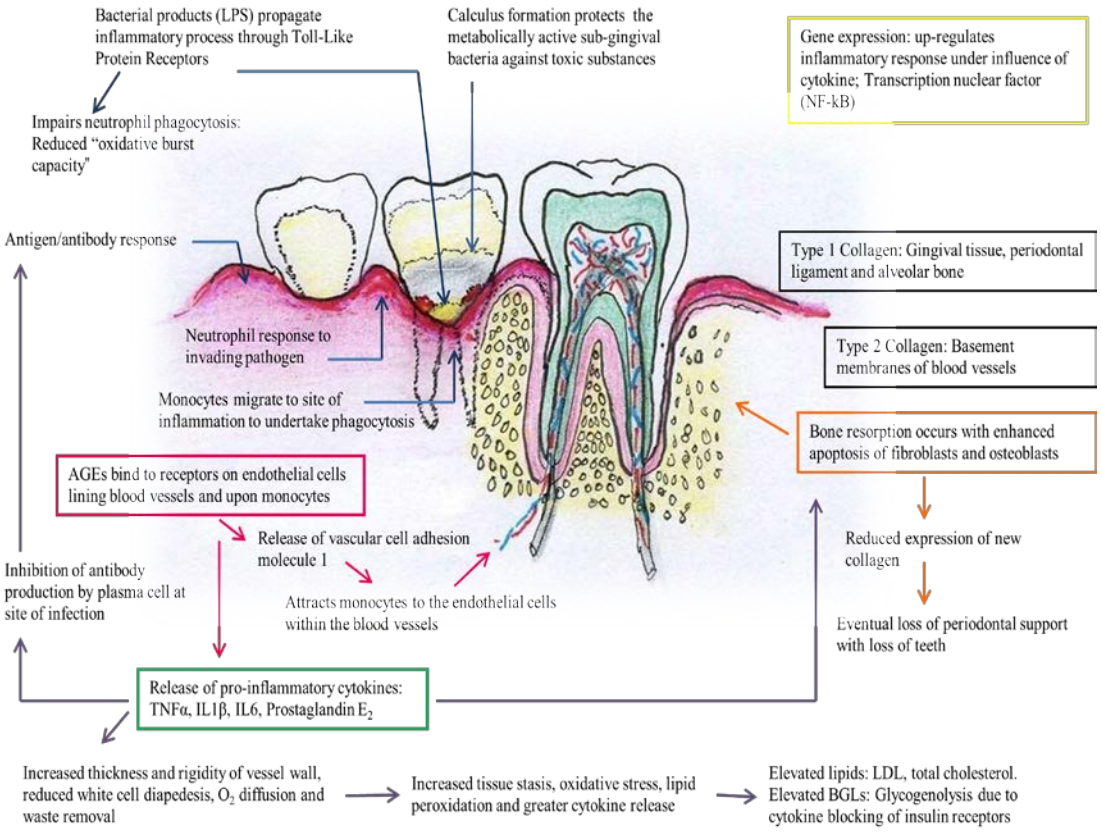

Figure 2.2 Pathogenesis of periodontitis in diabetes.

Smoking: The additional risk. The risk for periodontal disease associated with tobacco smoking has been extensively studied in cross-sectional, case-controlled, longitudinal and interventional studies, with results indicating smoking was an independent risk factor in the order of 2.5-7.0 compared to non-smokers (Salvi et al., 1997). The volume of cigarette consumption over time was positively correlated with increasing levels of risk for periodontal disease in current smokers with more severe periodontitis noted among those who currently smoked in comparison to those ex-smokers and the least severe observed in those who never smoked (Salvi et al., 1997).

In addition, the U.S National Institute for Dental and Craniofacial Research (2000) reports the odds ratio (OR) for severe periodontitis in individuals with diabetes who also smoke is increased to 20. According to Tsai, Hayes and Taylor (2002), dental examination data from the American NHANES III studies showed an OR = 2.3 for severe periodontal disease in patients who smoke and had better controlled diabetes (HbA_{1C} <9%) while patients who smoke and had poorly controlled diabetes (HbA_{1C} >9%) had an OR = 4.6, suggesting a combined effect of smoking and glycaemic control on developing periodontal disease.

Tobacco smoking introduces a highly reactive and toxic form of AGE products into the circulation (Peppa, Uribarri & Vlassara, 2003). One of the by-products of smoking, nicotine, exert vaso-constrictive effects, reducing not only blood flow, but also oedema and inflammation. Therefore, in the person who smokes, the outward clinical signs of periodontal disease may appear less aggressive despite the underlying damage (Hanes, Schuster & Lubas, 1991, as cited in Salvi et al., 1997). The biological effects of nicotine range from neutrophil chemotaxis at low concentrations to impaired phagocytosis at higher concentrations with up-regulated release of cytokines in response to the bacterial product, lipopolysaccharide, and reduced levels of immunoglobulin G_2 (IgG_2), which normally provides a key immune response against

periodontitis causing bacteria (Salvi et al., 1997). In addition, carbon monoxide (CO) rather than Oxygen (O_2), binds with haemoglobin (Hb) in the order of 210 times greater affinity. This results in decreased O_2 carrying capacity and a slower dissociation-rate of O_2 from Hb within the body's tissues. The resulting oxidative stress within the endothelial tissues increases their permeability, with oedema and fatty acid oxidation the end result (Rietbrock, Kunkel, Worner & Eyer, 1992). Furthermore, the decreased oxygen tension in the deep periodontal tissues creates a favourable environment for gram-negative organisms to flourish, with the gingival fibroblasts binding and internalising nicotine, re-releasing it un-metabolised (Loesche, Gustberti, Mettraux, Higgins, & Syed, as cited in Salvi et al., 1997, p. 185).

Thus the effect of smoking in the person with diabetes is to exacerbate the oral tissue destruction via up-regulation of the pathogenic factors previously discussed. This is in combination with the reduction of blood and oxygen volumes available within the oral tissues to enable repair, predisposes the individual to a greater risk of periodontal disease occurrence and severity.

Diabetes and oral health management strategies

In light of the research describing the bi-directional interaction of diabetes and oral health, providing evidence of greater prevalence, incidence, severity, extent or progression of periodontal disease in individuals with diabetes, the WHO called for careful management of periodontal disease in patients with diabetes as an adjunctive treatment to other regular diabetes care. The FDI, and IDF in their symposium, 'Oral Health and Diabetes' at the 2007 FDI Annual World Dental Congress in Dubai, recognised the need for greater awareness among healthcare providers and the general public for oral complications in diabetes. Further at this symposium, the FDI and IDF focussed on the need for more research and evidence-based education programs to

raise awareness of oral health complications and promotion of oral health care as a component of diabetes education and care (D'Aiuto & Massi-Benedetti, 2008).

There is some evidence to suggest that action has been taken towards improving oral health care for people with diabetes. At the World Diabetes Congress in 2009, the IDF launched its guideline 'Oral Health for People with Diabetes'. This guideline recommends the diabetes care provider should: enquire annually as to the frequency of a dental professional's review and the individual's oral hygiene practices, reinforce the need for oral health care as part of 'normal' diabetes self management, and provide advice as required. It also highlights oral assessment and patient education as to the implications of periodontal disease, with referral to a dental practitioner if symptoms are present. Peak bodies within America and Canada, i.e., the American Dental Association, American Diabetes Association, Diabetes Educators Association of America, Canadian Dental Association, and Canadian Dental Hygienists Association have position statements that identify their promotion of oral health care within diabetes management.

Within Australia, the Commonwealth Government endorses the National Health and Medical Research Council (NHMRC) framework for diabetes management via the provision of documents 'Clinical Practice Guidelines: Type 1 Diabetes in Children and Adolescents', and the 'National Evidence Based Guidelines for the Management of Type 2 Diabetes Mellitus – Part 1' (NHMRC, 2005a, 2005b). Within the 'Clinical Practice Guidelines: Type 1 Diabetes in Children and Adolescents' (NHMRC, 2005a) there is acknowledgment that "maintenance of dental health and the prevention of dental disease is important for children and adolescents with diabetes mellitus" (p. 180). Furthermore "the assessment of dental health should be a part of the regular medical follow-up" (p. 180). There is an explanation of periodontal disease signs and symptoms with the inclusion of oral hygiene practices for prevention, with

recommendations for “twice yearly examination” and “regular cleaning and scaling of teeth by the dentist” (p. 180). However, within the updated version, i.e. ‘National Evidence-Based Clinical Care Guidelines for Management of Type 1 Diabetes in Children, Adolescents and Adults’ (NHMRC, 2011), the oral health care needs of the person with diabetes is mentioned only once. In doing so, it cites Simpson et al. (2010) “Increased periodontal disease prevalence is also reported and may lead to improvement in glycaemic control when treated” (p.150). The guidelines are limited by a lack of oral health screening items to guide the DHP in undertaking the oral examination, and for information as to what constitutes the appropriate and timely referral to a dental practitioner for this diabetes age-specific population.

This is important as gingivitis precedes periodontitis (Loe, 1993; Salvi et al., 1997; Vernillo, 2003). Children with diabetes have been shown to exhibit not only greater incidence of gingivitis than non-diabetic children (Gustberti, Syed, Grossman & Loesche, 1983), but also a clear tendency towards higher gingival index scores when metabolic control is poor (Gislen, Nilsson & Matsson, 1980). It is identified that metabolic/glycaemic control in children with diabetes is frequently challenged by: the frequency of episodes of illness, heightened levels of activity which predisposes to hypoglycaemia requiring additional treatment with oral glucose, and the psychosocial issues impacting upon management of the condition (NHRMC, 2005a). In addition the physiological host changes during puberty can have a significant effect on glycaemic control and has been shown to further predispose the individual with diabetes to periodontal disease (Gustberti et al., 1983).

As identified by Lalla et al. (2006), in their study of children and adolescents, “periodontal diseases are largely preventable and progression of destruction can be best arrested when identified in early stage”. Furthermore, they state the opinion that “screening for periodontal changes and implementing prevention and treatment

programs should be considered as a standard of care for young patients with diabetes" (p. 299). This evidence is also supported by studies that indicate management of periodontal infections in adults with diabetes can have a positive effect on the glycaemic control in these individuals (D'Aiuto & Massi-Benedetti, 2008; Lalla et al., 2007; Salvi et al., 1997; Southerland, Taylor, Moss et al., 2006; Southerland, Taylor & Offenbacher, 2005).

Within the document 'National Evidence Based Guidelines for the Management of Type 2 Diabetes Mellitus- Part 1' (NHMRC, 2005b), there is an absence of information regarding diabetes related oral health complications. References to complication management extends only to general statements citing Colagiuri et al. (1995) "screening for and appropriate treatment of complications" and "additional expertise...should be available as required as should referral access to specialist services for the management of identified complications" (p. 2).

While there are Australian consensus statements, position statements and practice management guidelines for other complications associated with diabetes, those for oral health in diabetes care are notably lacking. The peak Australian bodies for DHPs, the Australian Diabetes Society (ADS) and the Australian Diabetes Educators Association (ADEA) do not appear to have endorsed any such related protocols.

Consumer information, concerning oral health issues associated with diabetes, is available as print and electronic resources. This is most notably from dental practitioners and dental health companies, such as Colgate Palmolive, or via organisations, such as The Australian Diabetes Council (2008), State-based member organisations of Diabetes Australia (Diabetes Australia 2006), and the Australian Research Centre for Population Oral Health (ARCPOH, n.d.a, n.d.b). In some Australian states, e.g., South Australia, the Government Department of Health and Human Services have been proactive in providing information that target older persons

and those within rural/remote communities (Government of South Australia, 2012). There has also been targeted promotion within the indigenous population of the Northern Territory (NT Government, 2007), as well as a broad health promotion approach by the Victorian Government via the 'The Better Health Channel' Website (Government of Victoria, 2010).

However, the paucity in Australian publications of evidence-based diabetes and oral health articles targeting DHPs' acquisition of knowledge and skills, practice guidelines and a screening tool to guide the assessment and referral processes for specialised care when problems exist, is of concern. Extensive searches via PubMed, ProQuest, CINAHL, Medscape, and Google Scholar databases utilising search term combinations, e.g., diabetes, type 1, type 2, adults, children, oral health, gingivitis, periodontitis, periodontal disease, oral health quality of life, complaints, conditions and complications, was undertaken. As a result it was determined that there was no previous evidence of studies pertaining to DHPs' knowledge and scope of practice within the Australian context. Two recent studies were found which specifically investigated the relationship between practitioner knowledge and clinical practice with the knowledge and self-management practices of oral health in individuals with diabetes. However, a direct comparison of data from these studies with Australian health practices is somewhat difficult given the cultural, educational and health system differences. Al-Habashneh, Barghout, Humbert, Khader and Alwaeli (2010), noted 70% of Jordanian doctors responding to their survey identified knowledge of the association of diabetes and oral health. However only 50% identified advising their patients of the need for dental management in diabetes care and only 30% agreed that oral health was an issue in diabetes control. Their data showed the significant factors in patients being advised was being a specialist in diabetes and positive knowledge of the association of diabetes and oral health. They concluded that:

> "There is limited knowledge of the relationship of oral health and diabetes. The more knowledgeable doctors are, the more likely they are to make dental referrals. Screening and referral by health professionals may benefit diabetic patients by improving access to dental care. Therefore, there is a need to educate doctors about oral health and diabetes" (p. 980).

In the second study, within an American community, Yuen et al. (2009) found "participants who received oral health information related to diabetes had 2.9 times the odds of demonstrating adequate oral health knowledge compared to participants who did not receive that information controlling for education and race (OR = 2.86, 95% CI 1.31–6.24, P = 0.008)" (p. 243). They further identified "consistent trends between specific oral health information received from health professionals and the specific self-reported oral health behaviours among dentate participants" (p. 244). This study showed the provision of diabetes and oral health information by DHPs did improve patient knowledge, and a statistically significant association between a particular area of oral health information received, and the frequency of engaging in specific oral health behaviours corresponded to the information received (p. 244).

In conclusion, it would appear from the limited studies of diabetes and oral health knowledge and clinical practice undertaken to date, that DHPs are ideally placed to provide information regarding diabetes and oral health information to the individuals in their care. As with any diabetes-associated complication, a concentrated focus is required to not only improve recognition, but also the implementation of education and health promotion, prevention strategies, and referral processes. The specialised management of identified oral health problems has been shown to improve the health, welfare and quality of life in the person with diabetes. These issues should be at the forefront of not only researchers, but also the practitioner involved in care management of the person with diabetes. It is unclear however, whether Australian DHPs possess

sufficient knowledge and skills to undertake oral health complication management within their practice. Furthermore, identification of the driving and restraining forces impacting on their scope of practice is required. The purpose of the current study is to explore the relationship of these issues further.

Chapter summary

This chapter has discussed the available evidence indicating the risks for periodontal disease in the individual with diabetes at the varying stages of age and by diabetes type. It has highlighted the differences in glycaemic control, age of onset and duration of the diabetes condition as the major influencing factors in incidence, prevalence and severity of periodontitis. Little statistical evidence exists to indicate the true periodontal prevalence rate in people living with diabetes, or potential for estimation of the magnitude of the periodontal disease rate in this vulnerable Australian population.

Building upon the information provided in Chapter 1, the oral health problems associated with diabetes was presented, describing both symptoms and issues for diabetes management. Periodontal disease pathogenesis was explored and presented in a manner to enable the reader to understand the compounding complexity and bidirectional nature of periodontal disease in diabetes and its impact upon the varied body systems, with the additional behavioural risk factor; cigarette smoking, discussed.

The literature regarding diabetes and oral health care strategies examined both international and national documents. In the absence of Australian oral health care specific position statements and guidelines for DHPs from diabetes peak body organisations, the NHRMC documents regarding management of diabetes were discussed. From these it was identified an insufficient level of attention has been given to oral health complications.

Finally the literature review identified only two previous studies which have explored the topic of knowledge of oral health complications and clinical practice in the area of diabetes management, with data indicating not only a significant lack of practitioner and patient knowledge, but also insufficient promotion and management of oral health problems within diabetes care models. The evidence from these studies indicate the view that the health professionals' knowledge and practice can have an impact upon preventing and managing oral health complications in individuals with diabetes, however further research is required to establish this outright. Therefore a study into the Australian health professionals' knowledge and scope of practice in the area of diabetes and oral health complications is worthy of further investigation.

Chapter 3: Methodology of the Study

This chapter describes the research design, sampling method, instrument development, data collection procedure and statistical analysis used to meet the study's aim. Ethical considerations are also discussed. The invitation to participate in the pilot and main phase of the study, the information sheet and data collection instrument are described.

Study design

This descriptive study utilised a cross-sectional design to survey the providers of specialised diabetes care in Australia. Members of the Australian peak organisations for DHPs, the ADS and the ADEA, were recruited as the study participants. These professional bodies represent health professionals who are direct service providers to people living with diabetes.

A cross-sectional approach is commonly used in health and social sciences to describe the prevalence of an association between a subject of interest and identified determinants of health in the study subjects at a single point in time (Levin, 2006; Moser & Kalton, 1986). It was therefore considered an appropriate method for this study in order to meet the objectives which were to:

1. Measure Australian DHPs' level of knowledge of oral health issues which impact upon the person with diabetes.
2. To describe the DHPs' scope of practice regarding intervention, health promotion and care management of oral health issues in persons with diabetes.
3. To identify the restraining and driving forces that influence the provision of oral health care prevention and intervention for people with diabetes.

The advantages associated with this form of design are that it is relatively inexpensive, with a shorter administration time, and without the requirement to follow-up the participants within the sample population (Levin, 2006; Moser & Kalton, 1986). Furthermore, multiple factors and outcomes of interest are able to be analysed thereby indicating associations which exist, thus allowing further hypothesis generation which is useful for future research (Barratt & Kirwan, 2009). Whilst the cross-sectional design was considered a suitable method for this study, there are however, notable disadvantages associated with this approach.

A major disadvantage in using a cross-sectional study design is its inability to establish a causal relationship between the variables of interest and outcome, nor the sequencing of the events leading to the outcome (Levin, 2006; Moser & Kalton 1986). As it was the intention of this study to measure and describe the association between the DHPs' knowledge and scope of practice in the delivery of care to people living with diabetes rather than the cause and effect relationship, this disadvantage was therefore not considered a barrier to achieve the study objectives.

A further disadvantage of a cross-sectional design is the increased susceptibility to bias (Barratt & Kirwan, 2009). Bias also known as systematic error, occurs when a factor or number of factors within a research study design has an effect upon the data acquired. This results in the systematic distortion of the true association between the study factors and the outcome factors (Dorak, 2009). The most commonly seen biases occur in the selection and measurement phases of a study. The response bias occurs when there is a low response rate. This could be important for the present study if sample size inequality within the professional sub-groups occurred, as the characteristics and responses of those who participate versus the non-responders may differ significantly. A recall bias, may occur when the participants' reflections upon their actual level of knowledge and recall of previous experiences have led them to

adjust their answers within the survey. It is acknowledged that these bias factors could arise within this study and are therefore considered in the analysis and reporting of the data presented in subsequent chapters.

The study comprised of two stages. Firstly, an initial pilot phase explored the measurement tools' construct; face and content validity, along with estimates of completion time. Amendments were made to the instrument based upon feedback from the pilot testing prior to use in the main study. Secondly, the main study concentrated upon the ethical considerations in undertaking the study, communication with the executive and administration staff of the sample groups to ensure the distribution of the instrument to their membership, the data collection period, analysis of the data collected and reporting of the results.

Sampling method

Participants were sought from the membership of the ADS and ADEA. The ADS and ADEA clinical practitioner membership for 2007-2008 was 404 and 1473 respectively. For this period the majority of the ADS membership represents medical professionals in endocrinology practice, research and teaching (94.1%). A further 5.9% of members were pharmaceutical representatives or otherwise not categorised (ADS, personal communication, January 19, 2009). The ADEA membership for this period comprises nurses (49.3%), dietitians (5.2%), other allied health professionals (1%), pharmaceutical representatives (1%), pharmacists and podiatrists (0.5% each), medical practitioners (0.1%) and a further 42.4% of members not categorised to a profession (ADEA, personal communication January 19, 2009). For the sample data to be representative of these organisations at a 95% confidence interval, it was calculated that 197 ADS members responses and 305 ADEA member responses was required (Sample size calculator, 2010).

All members of these two organisations were invited to be a part of the study. No exclusion criteria for participation existed. The invitation to participate in the study was disseminated via the organisations' email, and additionally, for the ADEA members, the 'members only' accessible pages on the organisation's website. Thus respondents involved in the study formed a convenience (a non-probability) sample. It is acknowledged that a weakness of this form of sampling method is its inability to ensure representation from the varied groups within the study population (Barratt & Kirwan, 2009). However, by involving ADS and ADEA an attempt was made to gain participants who have an interest in diabetes care sufficient to join these professional organisations. The decision was made to avoid approaching more general organisations, such as the Royal College of Physicians and General Practitioners, Nurses Registration Boards and registering bodies for each Allied Health Professional category in each State of Australia. This is explained further within Chapter 4.

Measurement tool

A survey was developed by the researcher for the study. An extensive literature search failed to identify any established instruments suitable for inclusion in this study, therefore, item generation for the study instrument was based upon the literature review, mapping of clinical evidence-based guidelines from dental and diabetes association's within the US, Canada and Europe and the research objectives guiding the study. The US, Canada and Europe were selected due to the existence of several research studies undertaken in the area of diabetes and oral health complications that resulted in the development of consensus statements for diabetes care management in these countries. This is in contrast to Australia where there is currently an absence of diabetes and oral health complication research with supportive clinical documents.

Given this, the instrument was tested prior to its use in the main study to determine its face and content validity, and reliability.

The instrument used in the main study was comprised of three parts and totalled 28 items (Appendix A). Part One addressed the socio-demographic data and consisted of ten questions seeking information on professional membership, employment experience, the nature of the participants' work setting and location (determined by postcode), and the principal diabetes population managed. Part Two focussed on the extent and form of diabetes and oral health education received by participants; a total of seven items, with two questions requiring participants to identify the extent of their knowledge of specific diabetes related oral health complications were included. Finally, the Part Three concerned participants' practice and efficacy relative to oral health issues in diabetes care. Eleven items related to diabetes and oral complication management practices undertaken and the levels of confidence in decision making which guided the practice. The form of the items was a mixture of open-ended and closed-ended questions, and Likert scale statements.

Open-ended items allow flexibility in testing the limits of respondents' knowledge. They also provide a frame of reference for respondents' answers with a minimum of restraint on the manner and content of the reply, thereby facilitating a richness and intensity of response (Burns, 2000). The closed items allow the respondent to choose from two or more fixed alternatives. The advantage of these items is that it achieves greater uniformity of measurement and therefore greater reliability in the data which, when used in conjunction with open-ended and scale items, overcomes the apparent superficiality of a forced ranking response (Burns, 2000). These items have been structured to account for the myriad of potential answers across each of the professional sub-groups as identified from the pilot phase testing. The Likert scale items are a set of statements to which the respondent has been

asked to consider a range of clinical circumstances and indicate their degree of agreement, confidence, concern and likelihood to action in their practice on a scale of 1 to 5. The lower score reflects a more negative response with the highest score reflecting a more positive response for each of the Likert items.

Data collection

Pilot Phase – Questionnaire validity and reliability testing. The instrument was circulated in word document format to a pilot panel of seven diabetes clinicians, including an Endocrinologist, a Registered Nurse with diabetes education qualifications, a student diabetes educator, two dietitians and two podiatrists. The diverse representation of health professional groups included in the pilot was deemed necessary to reflect the professions within the ADS and ADEA membership. These individuals responded to a group email request for participation in a pilot group and were sourced from the researcher's place of employment, a tertiary diabetes centre. There was no risk that the participating pilot members would later be included in the final study sample, as it was confirmed they were not members of the professional organisations sampled.

The pilot phase participants were provided with an explanation of the purpose and objectives of the study along with the Information sheet for pilot phase participants in reviewing the study questionnaire, (Appendix B). Further explanation was provided in the use of the Content Validity Index (Waltz & Bausell, 1983) (Appendix C) to enable an assessment of the face and content validity of the Study questionnaire (pilot phase version) (Appendix D). Further questionnaire refinement was based upon the feedback received (Appendix E).

Review of the instrument by the panel involved completion of the questionnaire twice. The instrument was provided at two separate occasions to measure the test-

retest reliability, with a period of 21 days between administrations. According to Huck and Cormier (1996), the basic idea of reliability can be summed up by the word consistency, with the test-retest approach representing an estimate of consistency overtime, providing a single numerical index called the reliability coefficient. A descriptive summary of the data consistency normally assumes a value between 0.00 and 1.00 with the two endpoints representing where consistency is either totally absent or total present. The degree of stability of an item with an increasing timeframe to re-test is usually reduced; therefore, a high coefficient of stability is more impressive when the time frame is longer (Huck & Cormier, 1996).

Recording of the instrument commencement and completion time. The participant's start and finish time was recorded on both occasions to enable estimation of the completion time for inclusion within the main study.

Completion of the Content Validity Index prepared by Waltz and Bausell (1983). The pilot phase participants were asked to critically review each question within the questionnaire against four criteria within the index: relevance, clarity, simplicity and ambiguity. The rating scale ranges between 1 'not relevant' to 4 'very relevant', refer to Table 3.1.

Table 3.1
Content Validity Index

Rating	Criteria
1	Not relevant
2	Item needs some revision
3	Relevant, but needs some minor revision
4	Very relevant

Content validity is concerned with the degree to which the various items collectively cover the material that the instrument is supposed to measure (Huck &

Cormier, 1996). This can be determined from the literature review, representatives of the sample population and clinical experts who carefully compare the content of the test against an outline that specifies the instruments' claimed domain (Burns & Grove, 1993). Subjective opinion from these experts may either establish or not, the content validity without statistical procedures being applied to the data (Huck & Cormier, 1996). The detailing of the content validity process is an important factor in identifying the concept of measuring and thus ensuring the interpretations of results are precise (Yaghmaie, 2003).

Assessment of the study instruments' content validity was completed on one occasion only during the pilot phase. A further column was added to the index to enable the panel members to recommend changes to further improve the questionnaire, thereby addressing the face validity, which is the presentation of items within the instrument in relation to the question formulation and order. The evaluative comments resulted in modifications to the instrument before their transcription into the electronic format for distribution to the study sample. In general these changes were to wording to improve clarity in the questioning, and the addition of questions to expand and improve the data collection. A full description of these changes is reported within Appendix E.

Second stage: Main study. Contact with the ADEA and ADS organisations were initiated by email (Appendices F and G) prior to the study being approved by the Curtin University of Technology Human Research and Ethics Committee. This was done to gauge the organisations' levels of interest and potential support for the research project.

Feedback from both organisations requested further information on the research methodology and ethical considerations whilst in-principle support for the study was

indicated. A further submission to the ADEA and ADS Executive Boards was made. This included the research proposal which, contained the study questionnaire (pilot phase) version one, the Participant information sheet version one and the Curtin University of Technology Human Research and Ethics Committee Approval 2009 (Appendix H). Following their consideration of the documentation, a preparedness to progress support for the electronic dissemination to their memberships was communicated.

During the time period in which final changes to the study questionnaire and transcription into the electronic format were undertaken, changes to the Executive Board of Management membership for both the ADEA and ADS occurred. This in conjunction with further disruption to telephone, email and website functions due to office relocation along with staff leave resulted in a significant delay in the dissemination of the finalised survey. A secondary review of the documents was required by the new executive members of the ADS with feedback identifying a requirement for a Curtin University of Technology Human Research and Ethics Committee Approval document that would extend past the planned survey distribution date (Appendix I). A further requirement was that the information on the background of the study be contained within the Study invitation to ADEA and ADS members (version one) (Appendix J) as well as a request to place the revised Participant Information Sheet (version one) (Appendix K) ahead of the Study questionnaire, within the electronic format upon the SurveyMonkey website prior to the secondary approval for dissemination to the membership.

"SurveyMonkey" is an easy-to-use web based tool for the creation of online surveys (SurveyMonkey, 2009). Its primary strength is its interface with the Statistical Package for Social Sciences (SPSS), which enabled the electronic collection and transport of study participants' data into the SPSS program for further analysis. Given

a page word limit constraint within the SurveyMonkey format and mindful of the need to meet the ADS requirements to keep information succinct for the survey respondents, further amendments to the Study invitation to ADEA and ADS members (version two) were necessary (Appendix L), with a final decision made to keep the format of the Participant Information sheet (version two) the same for distribution to both the ADEA and ADS membership via the SurveyMonkey website, (Appendix M).

The ADEA membership was the first to receive the invitation posted on the ADEA member only Webpage on May 17th, 2010; however a limited response to the questionnaire, of 2 members within the first seven days, was received. A further request of the ADEA administration to distribute an individual invitation to members via emailed newsletter resulted in an improved response rate totalling 117 members by June 6th. Another notice of the survey extension to July 1st was posted on the members' website with a further 23 member responding to the questionnaire. Three further ADEA members accessed the questionnaire past this date, due to delayed closure of the SurveyMonkey collector for the ADS members.

The ADS members received their invitation via an emailed newsletter on June 2nd, 2010, which resulted in five responses in the first five days. Communication with the ADS administrative staff informed them of the poor response with a further request for the distribution of an individual invitation to the membership via email in additional to an ADS Webpage link to the survey. However, feedback from the ADS executive informed this was rejected in favour of a second invitation, within the electronic newsletter distributed to the membership on August 5th, 2010 (Appendix N). The outcome remained limited to a total response rate of 13 participants received by the extended survey closure date of August 22nd, 2010. As a result of administrative factors, outside of the control of the researcher, the combined survey of the sample populations from the planned four week survey period was extended.

Closure of the online questionnaire occurred on 17th September, 2010. The date of the last survey response was September 11th, 2011.

Data analysis

The data collected was analysed using the Statistical Package for Social Sciences (SPSS), version 20. Percentages and frequencies with measures of central tendency and variability where appropriate were calculated, with percentage rates rounded and reported to the first decimal place. Cross tabulations and Pearson's Chi-Square Tests were used to determine the relationships between categorical variables, for example, health professional groups' oral health education and their recommendations for patient care in practice. In addition parametric tests, t-test and ANOVAs were used on normally distributed data to seek relationships between demographics and nominal data. Where assumptions of normality were not met, the non-parametric equivalents Mann-Whitney U Tests and Spearman's Rank-Order Correlation Tests were utilised to measure differences between and amongst subgroups of the sample. In addition, the internal reliability of the instrument was assessed. Tables were used as appropriate to illustrate the data.

Ethical considerations

Permission to conduct this study was sought from the Human Research Ethics Committee at Curtin University of Technology. In addition, support for the project was gained from the ADEA and ADS executive boards with consideration of the research proposals undertaken by their respective research committees.

This project adhered to the NHMRC guidelines for the ethical conduct in research involving humans (2007a, 2007b). The study was considered to be minimal risk; as no harm was expected to any participants. Completion of the electronic questionnaire was

considered implied consent. Participants were not coerced into participation through inducements nor payments. Personal identification details were not required and the information obtained remains anonymous. Storage of data will be maintained for a period of five years in a locked file at the home of the researcher.

In summary, this chapter described the advantages and disadvantages of the cross-sectional research design used to survey the Australian diabetes health service professionals via the ADEAS and the ADS. The sampling method for this study was a convenience sample of members who completed the questionnaire developed by the researcher from an extensive literature review, mapping of clinical evidence-based guidelines from appropriate sources and the research objectives guiding the study. A description of the questionnaire parts as well as the individual questions was provided, along with the explanation of amendments made to the instrument as a result of the pilot phase testing prior to its implementation within the main study. Finally the statistical analysis undertaken on the data acquired was detailed, as were the ethical considerations in undertaking the study. In the following chapter, the results of the study are detailed

Chapter 4: Results of the Study

This chapter presents the findings of the study against the three study objectives. It identifies the socio-demographic characteristics of the sample population of Australian DHPs and the patient population they manage. It measures the level of the participants' knowledge of diabetes and oral health complications, and describes their scope of practice in regard to the intervention, health promotion and management of oral health complications in the person with diabetes. Along with this is the identification of the driving and restraining forces influencing the DHPs' decision making practices that impact upon the level of intervention and preventative care implemented for their patients experiencing oral health problems.

Initial analysis

Statistical analysis performed on the data used a significant level of alpha < 0.05 for all tests. The results of the univariate tests are presented first. The Kolmogorov-Smirnov Statistic (with Lilliefors Correction) was used to test the assumption of normality for all variables prior to the undertaking of bivariate analyses. Where this was significant (p <0.05), indicating the violation of the assumption of a normal distribution, a logarithmic transformation of data was undertaken. Despite the attempts at transformation using natural logarithm, logarithm to the base 10, and adjustment using the square root of the skewed variables, the normality of variables remained inconsistent and therefore inconclusive. The inconsistency was particularly true for the professional categories and the items' levels of confidence. Thus, as recommended by Bland (2005), the non-parametric Mann-Whitney U Test and Spearman's Rank Correlation Test were employed for outcomes. The data test statistics are herein reported against the probability value < 0.05 two tailed unless otherwise indicated.

Sample response rate

Participants were sought from the membership of ADS and ADEA. The ADS and ADEA clinical practitioner membership for 2007-2008 was 404 and 1473 respectively. From this membership, 153 members (8.2%) responded to the electronic invitation to participate by accessing the online questionnaire. This low response rate is a recognised limitation of this study and the results obtained should be interpreted with caution.

The questionnaire was organised in an *a priori* manner to retain the respondents' interest and to achieve a high completion rate. Given the potential for clinical practice diversity among participants, it was considered necessary to limit the number of items which were not applicable. As a result, on four occasions participants were directed to skip subsequent items that were not relevant to their situation and to proceed to the next section of the questionnaire. This, along with the unexplained attrition of 21 participants at various stages of the survey, accounts for the change in the number of survey responses noted across the survey data.

Furthermore, 12.4% (n = 19) of participants indicated they did not undertake assessment or screening of oral health status as part of the diabetes management. At this point, these individuals were advised that they had completed the survey and were asked to submit their responses.

Socio-demographic characteristics of the participants

Professional membership. Of the 153 participants, just over 90% were members of the ADEA with the remainder being members of the ADS. Nearly three-fourths of participants were credentialled by their organisations, as detailed within Table 4.1. The professional representation included 123 diabetes nurse educators, 10 endocrinologists and 6 dietitians. The remaining nine participants identified themselves as endocrinology trainees, diabetes nurse practitioners, podiatrist, oral health therapist, university nursing academic, and Registered Nurses with dual professional roles, one of which was within the area of diabetes care.

Table 4.1
Professional Membership Status of Participants

Professional membership status	Frequency	Percent
Organisational membership		
Australian Diabetes Society	13	8.5
Australian Diabetes Educators Association	140	91.5
Credentialed status		
Currently credentialled	113	73.9
Not credentialed	40	26.1

Work location and setting. The work location, setting and roles performed in diabetes care varied among the sample. The majority of participants were from Victoria (30.1%) and New South Wales (20.3%), with the least representation from the Australian Capital Territory (2.6%) and Northern Territory (2.0%). The greatest proportion worked within a public hospital (43.1%), community health centre (20.9%) and the general practice setting (11.1%). Analysis via a Pearson Chi–Square Test did not find a significant preference among the participants for a primary employment setting across the various States and Territories (see Table 4.2).

Table 4.*2*
Descriptive Statistics for Participants' Primary Employment Setting by Australian State or Territory

Participants' primary employment setting	Australian State and Territories								Total
	NT	ACT	NSW	VIC	QLD	SA	TAS	WA	
Private practice									
Frequency	0	2	5	2	0	2	1	1	13
% work in private practice setting	0.0	15.4	38.5	15.4	0.0	15.4	7.7	7.7	100
% of setting within Australian State or Territory	0.0	50.0	16.1	4.3	0.0	14.3	4.3	5.9	8.5*
General practice									
Frequency	1	0	4	8	0	1	1	2	17
% work in general practice setting	5.9	0.0	23.5	47.1	0.0	5.9	5.9	11.8	100
% of setting within Australian State or Territory	33.3	0.0	12.9	17.4	0.0	7.1	4.3	11.8	11.1*
Public hospital									
Frequency	1	1	13	15	5	6	18	7	66
% work in public hospital setting	1.5	1.5	19.7	22.7	7.6	9.1	27.3	10.6	100
% of setting within Australian State or Territory	33.3	25.0	41.9	32.6	33.3	42.9	78.3	41.2	43.1*
Private hospital									
Frequency	0	0	0	1	1	2	1	1	6
% work in private hospital setting	0.0	0.0	0.0	16.7	16.7	33.3	16.7	16.7	100
% of setting within Australian State or Territory	0.0	0.0	0.0	2.2	6.7	14.3	4.3	5.9	3.9*
Community health centre									
Frequency	0	1	5	13	5	2	1	5	32
% work in community health centre setting	0.0	3.1	15.6	40.6	15.6	6.2	3.1	15.6	100
% of setting within Australian State or Territory	0.0	25.0	16.1	28.3	33.3	14.3	4.3	29.4	20.9*

Table 4.2 Continuation

Descriptive Statistics for Participants' Primary Employment Setting by Australian State or Territory

Participants' primary employment setting	Australian State and Territories								Total
	NT	ACT	NSW	VIC	QLD	SA	TAS	WA	
Other primary setting									
Frequency	1	0	4	7	4	1	1	1	19
% work in other primary setting	5.3	0.0	21.1	36.8	21.1	5.3	5.3	5.3	100
% of setting within Australian State or Territory	33.3	0.0	12.9	15.2	26.7	7.1	4.3	5.9	12.4*
Total									
Frequency of all primary employment settings	3	4	31	46	15	14	23	17	153
% of all primary employment settings	2.0	2.6	20.3	30.1	9.8	9.2	15.0	11.1	100
% of all settings within Australian State or Territory	100	100	100	100	100	100	100	100	100

Note. *Total percentage of participants across all Australian States and Territories working within the primary employment setting.

Of the 19 participants who indicated an 'Other' primary employment setting, the descriptions offered for this category included: Aboriginal health services, correctional health facility, non-Government and not-for-profit organisations, Divisions of General Practice, community nursing agencies, rural and remote area health services, residential aged care facilities, diabetes clinical trials, university, and private mobile diabetes service. This illustrates the diverse clinical settings in which DHPs practice. The descriptive statistics for these 'Other' responses may be located within Appendix O.

Work experience within diabetes care management. Within the sample 69.3% (n = 106) of participants indicated they worked solely in diabetes care with a further 22.2% (n = 34) stating they did not. The remaining 8.5% (n = 13) indicated a working role that, while not the primary focus, included diabetes care. These included a lecturer working within the tertiary education setting, along with those who practice clinically within endocrinology, internal and general medicine, and endocrine nursing. Furthermore, roles in areas such as lifestyle modification programs for diabetes prevention, chronic disease self-management programs, medication management, cardiac rehabilitation programs, general practice nursing, and private practice nursing where eighty percent of the clientele had diabetes, were identified. A Registered Nurse, and a Dietitian who also managed clients with conditions other than diabetes such as coeliac disease, obesity, coronary health, and malnutrition, identified part-time roles. This data indicates DHPs in these roles, while not primarily working in the area of diabetes management, have significant input into the care of people who live with diabetes. It would appear that these DHPs were in a position to perform an assessment for diabetes related oral health complications or otherwise, advocate for oral health service delivery to these patients.

The ‘years of experience’ data were collected from 119 individuals (77.8%) who worked specifically with people living with diabetes. The 34 individuals (22.2%) who identified working within a generalised health care area were not required to answer this question. Overall most DHPs working solely in diabetes care were concentrated in the 1-5, 6-10 and 11-15 year categories detailed in Table 4.3. These year categories were also reflected by those participants who identified having work roles that were not solely within diabetes specific care management, yet were qualified and whose clinical practice overlapped into caring for people living with diabetes. They are identified in the column labelled ‘Other’ within Table 4.3.

Table 4.3
Descriptive Statistics for Participants' Experience in Diabetes Care Management

Years of experience in diabetes care	Work solely in diabetes care		Total
	Yes	Other	
< 1 year (4.2%)			
Frequency	5	0	5
% with <1 year experience	100.0	0.0	100
% working solely in diabetes care	4.7	0.0	
1 - 5 years (26.9%)			
Frequency	27	5	32
% with 1-5 years experience	84.4	15.6	100
% working solely in diabetes care	25.5	38.5	
6 - 10 years (26.1%)			
Frequency	28	3	31
% with 6-10 years experience	90.3	9.7	100
% working solely in diabetes care	26.4	23.1	
11 - 15 years (23.5%)			
Frequency	24	4	28
% with 11-15 years experience	85.7	14.3	100
% working solely in diabetes care	22.6	30.8	
16 - 20 years (11.8%)			
Frequency	13	1	14
% with 16-20 years experience	92.9	7.1	100
% working solely in diabetes care	12.3	7.7	
21 - 25 years (4.2%)			
Frequency	5	0	5
% with 21-25 years experience	100.0	0.0	100
% working solely in diabetes care	4.7	0.0	
> 25 years (3.4%)			
Frequency	4	0	4
% with < 25 years experience	100.0	0.0	100
% working solely in diabetes care	3.8	0.0	
Total			
Frequency	106	13	119
% within all years of experience	89.1	10.9	100
% working solely in diabetes care	100.0	100.0	

Of those participants who identified working solely in diabetes care, the majority (48.1%, *n* = 51) worked within a public hospital, 20.8% (*n* = 22) within a community health centre, 9.4% (*n* = 10) within GP practices, 7.5% (*n* = 8) within private practice, and 2.8% (*n* = 3) within a private hospital setting. A further 11.3% (*n* = 12) identified working within an 'Other' setting as outlined previously and within Appendix O. To examine if there was a relationship between those participants who work solely in diabetes care and the length of experience in the area, the data for those variables were analysed using the Pearson's Chi-Square Test. The findings were not statistically significant.

Management of the patient population according to age. Participants were asked to nominate age groupings for the people whose diabetes care they managed. Ninety-six percent of participants in the survey (*n* = 150) categorised the management of their patient population across the age continuum from "Least" to "Most managed" or, otherwise indicated they did not work with patients within the age category. The frequency and percentage rates for patient populations by age group categories are detailed within Table 4.4.

Table 4.4
Descriptive Statistics for Participants' Management of Diabetes Patient Population by Age Group

Management Status	Age Group					
	Paediatric		Adolescent		Adult	
	n	%	*n*	%	*n*	%
Most managed	8	5.2	4	2.6	143	93.4
Second most managed	7	4.6	104	68.0	2	1.3
Least managed	40	26.1	7	4.6	3	2.0
Do not see	95	62.1	35	22.8	2	1.3
Not answered	3	2.0	3	2.0	3	2.0
Total	153	100.0	153	100.0	153	100.0

Management of patients from groups with more specific management needs or who are socially isolated. Within the survey, participants were asked to identify whether they worked with patients who were from a range of special needs groups. These groups reflect individuals who may have more specialised diabetes education and management needs or, were limited in their access to oral health services due to social isolation. A total of 145 participants (94.8%) indicated that they indeed worked with the patient groups identified. In addition, three participants acknowledged working with patients within the 'Other' option. The frequencies and percentage rates for each of the nominated patient groups are described in Table 4.5.

Table 4.5
Descriptive Statistics of Special Needs Patient Groups Seen by Participants

Client Group	Frequency	% of n^a
Patients from culturally and linguistically diverse backgrounds	114	76.0
Physically and intellectually disabled	107	71.3
Pregnant women	102	68.0
Aboriginal or Torres Strait Islander people	94	62.7
Residential Aged Care clients	79	52.7
Rural and/or Remote communities	64	42.7
Clients within secure facilities	41	27.3
None of the above patients seen	5	3.3
Other	3	2.0
Aged care in the home		
Mental illness		
War Veterans		

Note. n^a = percentage of total, n = 145

Education in diabetes related oral health complications

To achieve the first objective of this study, which was to assess the Australian DHPs' levels of knowledge of oral health issues impacting on the persons with diabetes, the participants were asked to identify their prior education in diabetes and oral health complications. This section, which formed Part 2 of the questionnaire, was completed by 96.1% (n = 147) of participants. Included items sought to determine the

manner in which education may have been delivered; part of a structured formal course or through self-directed learning. If the respondents answered in the negative, they were advised to skip two questions which were not applicable. This in part accounts for the variation in the total numbers of participants seen in the results across this section. Furthermore, the responses from these health professionals were categorised into three defined groups: endocrinologists, diabetes educators, and allied health professionals. This was to enable data analysis within and between groups. Table 4.6 illustrates the frequencies and percentages for each professional group within the items which identified the form of education in diabetes and oral health complications that had been undertaken.

Of those participants who recalled receiving education in oral health complication as part of their professional education course, the greatest proportion was diabetes educators (40.0%), followed by allied health professionals (20%), and endocrinologists indicating the least (16.7%). A slightly larger percentage of participants within the allied health professional (60%) and diabetes educator (55.2%) groups identified having attended an education session on diabetes related oral health complications either within the last five years or greater than five years prior, in comparison to the endocrinologist group (41.7%) who recalled diabetes and oral health complication education occurring only within the last five years. Those participants (n = 80) who had attended an education session were asked to further identify the form in which this education was delivered. This included 39% (n = 59) attending a professional association session and only 9.2% (n = 14) having the information delivered at an in-service session. Others received the information at a university (3.9%, n = 6) and at an industry sponsored seminar (1.3%, n = 2). A further 1.3% (n = *2*) of respondents identified a presentation by either a dental care company representative or a medical registrar as the ‘Other’ form of education received.

One-third of participants (n = 49) reported undertaking diabetes and oral health self-directed learning. A comparison of the results among the professional groups indicated the endocrinologists showed greater initiative (41.7%) than diabetes educators (33.9%) and allied health professionals (20%) in respect to this. The forms used to acquire the extra knowledge for the most part involved journals (19.6%, n = 30). To a lesser extent the use of web-based instructional modules (2.6%, n = 4), core textbooks (1.3%, n = 2), or a combination of all/most of these (7.2%, n = 11) were reported. A further 3.9% (n = *6*) identified 'Other' forms of self-education. The descriptive statistics for the responses obtained may be located within Appendix P.

Table 4.6
Descriptive Statistics for Participants' Education in Diabetes and Oral Health Complications by Professional Category

Education form undertaken	Endocrinologist			Diabetes Educator			Allied Health Professional		
	n	%[a]	%[b]	*n*	%[a]	%[b]	*n*	%[a]	%[b]
Oral health complications covered in professional education									
Yes	2	3.7	16.7	50	92.6	40.0	2	3.7	20.0
No	10	19.2	83.3	36	69.2	28.8	8	11.5	60.0
Cannot recall	0	0	0	39	95.1	31.2	2	4.9	20.0
Total	12	8.2	100.0	125	85.0	100.0	10	6.8	100.0
Attended education session on diabetes and oral health complications									
No	7	10.4	58.3	56	83.6	44.8	2	6.0	40.0
Yes, in last 5 years	5	7.6	41.7	58	87.9	46.4	3	4.5	30.0
Yes, more than 5 years ago	0	0	0	11	78.6	8.8	3	21.4	30.0
Total	12	8.2	100.0	125	85.0	100.0	10	6.8	100.0
Undertaken self-directed learning									
No	7	7.2	58.3	82	84.5	66.1	8	8.2	80.0
Yes	5	10.2	41.7	42	85.7	33.9	2	4.1	20.0
Total	12	8.2	100.0	124	84.9	100.0	10	6.8	100.0

Note. %[a] = Percentage of professional group identified within the oral health educational sub-category, *%[b]* = Professional group proportion within specified educational category.

Education undertaken across the professional categories. To examine the statistical relationship between the variables 'professional categories' and 'education', the Pearson Chi-Square Test was employed. The findings indicated a statistically significant association between the categories of health professionals and the receipt of diabetes related oral health education within their professional course (χ^2 [4, *n = 147*] = 17.546, $p = 0.002$). However, this result should be viewed with caution given the small sample size obtained within the endocrinologist and allied health professional categories. For this reason the Fisher's Exact Test statistic was consulted, this provided very strong evidence of an association ($\chi^2 = 15.874$, $p = 0.001$).

The data results from the Pearson Chi-Square analyses of the associations between the individual health professional groups and their attendance at an education session, along with the undertaking of self-directed learning in diabetes and oral health complications were not found to be statistically significant. A final Pearson Chi-Square analysis of the association between the professional categories and their undertaking of diabetes related oral health education via a combination of delivery methods were also not found to be statistically significant.

Extent of knowledge of diabetes related oral health complications

To ascertain the level of knowledge of diabetes related oral health complications, participants ($n = 147$) were asked to categorise their knowledge of an association of diabetes with a grouping of known oral problems. On three occasions false options were included within the question item as a means to determine whether participants had carefully considered the information and expressed their knowledge accurately. Participants correctly acknowledged an association of diabetes with the following conditions: gingivitis (94.6%), periodontitis (85.0%), dental caries (84.4%), candidiasis (81.0%), xerostomia (72.1%), and mouth ulcers (69.4%).

While none of the proposed diabetes associated oral health problems were rejected outright, the three false conditions (oral cancerous lesions, excessive salivation and dysphagia), did have a larger 'No' count than those of the actual conditions. The largest number of 'Don't know' responses, which indicated participants' lack of knowledge of an association with diabetes, was for lichen planus (76.9%), glossodynia and stomatopyrosis (77.6%), oral neurosensory dysesthesia (72.8%), and taste impairment (51%). This was in addition to the false conditions: oral cancerous lesions (68%), excessive salivation (61.2%), and dysphagia (50.3%). This indicates a lack of knowledge of diabetes associated oral health problems in the participants who responded in this manner. Relevant descriptive statistics are detailed in Table 4.7.

Table 4.7
Descriptive Statistics of Participants' Knowledge of an Association Between Diabetes and Oral Health Problems With the Receipt of Education

Oral health problem With any oral health education undertaken	Knowledge of association with diabetes						Chi-Square with Fisher's Exact Test Statistic	
	Yes		No		Don't know			
	n	%	*n*	%	*n*	%	$\chi^2(n = 147, df = 2)$	*Asymp. Sig* (two-tailed)*
Glossodynia and Stomatopyrosis	29	19.7	4	2.7	114	77.6	0.718	0.770
Education - Yes	24	21.1	3	2.6	87	76.3		
Education - No	5	15.2	1	3.0	27	81.8		
Candidiasis	119	81.0	2	1.4	26	17.7	6.640	0.310
Education - Yes	97	85.1	2	1.8	15	13.2		
Education - No	22	66.7	0	0	11	33.3		
Dental caries	124	84.4	7	4.8	16	10.9	4.356	0.113
Education - Yes	99	86.8	6	5.3	9	7.9		
Education - No	25	75.8	1	3.0	7	21.2		
Gingivitis	139	94.6	1	0.7	7	4.8	0.810	0.733
Education - Yes	108	94.7	1	0.9	5	4.4		
Education - No	31	93.9	0	0	2	6.1		
Mouth ulcers	102	69.4	4	2.7	41	27.9	0.982	0.669
Education - Yes	81	71.1	3	2.6	30	26.3		
Education - No	21	63.7	1	3.0	11	33.3		
Lichen planus	29	19.7	5	3.4	113	76.9	0.598	0.843
Education - Yes	24	21.1	4	3.5	86	75.4		
Education - No	5	15.2	1	3.0	27	81.8		

Table 4.7 (continuation)

Oral health problem	Knowledge of association with diabetes						Chi-Square with Fisher's Exact Test Statistic	
	Yes		No		Don't know			
With any oral health education undertaken	*n*	%	*n*	%	*n*	%	$\chi^2(n = 147, df = 2)$	*Asymp. Sig* (two-tailed)*
Oral neurosensory dysesthesia	37	25.2	3	2.0	107	72.8	2.704	0.277
Education - Yes	32	28.1	2	1.8	80	70.2		
Education - No	5	15.2	1	3.0	27	81.8		
Oral cancerous lesions	9	6.1	38	25.9	100	68.0	0.501	0.889
Education - Yes	8	7.0	29	25.4	77	67.5		
Education - No	1	3.0	9	27.3	23	69.7		
Periodontitis	125	85.0	2	1.4	20	13.6	2.302	0.283
Education - Yes	99	86.8	2	1.8	13	11.4		
Education - No	26	78.8	0	0	7	21.2		
Excessive salivation	17	11.6	40	27.2	90	61.2	4.177	0.115
Education - Yes	11	9.6	35	30.7	68	59.6		
Education - No	6	18.2	5	15.2	22	66.7		
Taste impairment	56	38.1	16	10.9	75	51.0	0.866	0.715
Education - Yes	43	37.7	14	12.3	57	50.0		
Education - No	13	39.4	2	6.1	18	54.5		
Xerostomia	106	72.1	4	2.7	37	25.2	0.958	0.660
Education - Yes	84	73.7	3	2.6	27	23.7		
Education - No	22	66.7	1	3.0	10	30.3		
Dysphagia	28	19.0	45	30.6	74	50.3	0.222	0.932
Education - Yes	21	18.4	35	30.7	58	50.9		
Education - No	7	21.2	10	30.3	16	48.5		

*Note. *P <0.05*

The Pearson's Chi-Square with Fisher's Exact Test was used to investigate the relationship of diabetes related oral health education upon the participants' ability to correctly identify signs and symptoms of oral health issues. Results, displayed in Table 4.7, indicate a single significant association between the participants who had undertaken combined forms of education, with the ability to identify candidiasis as being associated with diabetes (χ^2 [2, n = 147] = 6.640, p = .03). As a result, further analysis of the association between participants' diabetes related oral health education, in each of its forms and the ability to correctly identify diabetes related oral health problems was undertaken. The data shown in Table 4.8 indicates statistically significant results in the category of self-directed learning with the oral health problems: glossodynia/stomatopyrosis (χ^2 [2, n = 146] = 7.280, p = .020), candidiasis (χ^2 [2, n = 146] = 8.227, p = .007), and dental caries (χ^2 [2, n = 146] = 6.727, p = .033). No other statistically significant associations were found.

Table 4.8

Chi-Square With Fisher's Exact Test Statistics for Knowledge of an Association Between Diabetes and Oral Health Problem by Type of Education

Oral health problem	Type of diabetes and oral health education (n =146)					
	In Professional course		Attended session		Self-directed learning	
	$\chi^2(n = 147, df = 2)$	*Asymp. Sig* (two-tailed)*	$\chi^2(n = 147, df = 2)$	*Asymp. Sig* (two-tailed)*	$\chi^2(n = 146, df = 2)$	*Asymp. Sig* (two-tailed)*
Glossodynia and Stomatopyrosis	5.949	0.161	4.461	0.332	7.280	0.020*
Candidiasis	3.152	0.509	4.041	0.390	8.227	0.007*
Dental caries	1.216	0.913	6.469	0.128	6.727	0.033*
Gingivitis	4.786	0.238	5.588	0.184	4.181	0.096
Mouth ulcers	4.205	0.357	4.869	0.275	1.359	0.562
Lichen planus	2.546	0.652	3.790	0.384	0.666	0.725
Oral neurosensory dysesthesia	3.769	0.419	6.063	0.152	5.151	0.077
Oral cancerous lesions	4.528	0.335	6.626	0.134	5.840	0.049*
Periodontitis	1.258	0.977	5.803	0.158	1.141	0.573
Excessive salivation	6.271	0.176	6.556	0.145	2.655	0.276
Taste impairment	4.972	0.292	0.985	0.935	2.662	0.283
Xerostomia	3.695	0.433	2.948	0.533	2.106	0.372
Dysphagia	1.948	0.757	5.091	0.276	0.314	0.844

*Note. *P <0.05*

Acknowledgement of risk for oral health complications in people with diabetes

The final question of participants within this section was to quantify whether there was awareness of the potential for oral health complications in people with diabetes in the absence of other diabetes related complications. The low mean score (M = 1.80, SD ± 1.059, 95% CI = 1.62, 1.97) from the potential score range of 1 to 5 ('Strongly disagree' to 'Strongly agree') indicates that the participants did not agree with the item, "The significance of an increased risk of oral health problems in people with diabetes was *only* relevant *if* the patient had been diagnosed with another diabetes related complication".

Diabetes and oral health complications: Scope of practice and efficacy

In accordance with the second objective of this study, the participants' scope of practice was explored. This related specifically to the level of confidence to assess patients' oral health signs and symptoms. The participants' decision making, especially if the patient presented with signs of other diabetes related complications, was investigated. Also determined were their levels of likelihood to undertake diabetes related oral complication management and their levels of confidence to provide information to patients.

Levels of confidence in assessment of oral health signs and symptoms and provision of diabetes related oral health information. As shown in Table 4.9, the low mean scores for all three variables, out of a potential range of 1 to 5 ('Not confident' to 'Very confident' or 'Highly unlikely' to 'Highly likely'), indicate the participants did not perceive they were confident in either assessing oral health signs or symptoms or providing diabetes related oral health information. They were less likely to investigate dental problems if the patient had other complications related to their

diabetes. Overall there appeared a slightly higher level of confidence among participants to provide diabetes related information to patients than to assess for signs and symptoms of oral health problems at a consultation.

Table 4.9
Descriptive Statistics for Participants' Levels of Likelihood and Confidence in Assessment of Oral Health Status and Provision of Diabetes Related Oral Health Information

Questionnaire item	Mean	SD	95% CI
Confidence in assessing oral health signs and symptoms in people with diabetes	2.37	1.043	[2.20, 2.54]
Confidence in providing diabetes related oral health information	2.91	1.064	[2.73, 3.08]
Likelihood to investigate dental problems if patient has other diabetes related complications	2.83	1.317	[2.62, 3.05]

Note. $n = 144$

The impact of education upon levels of confidence. Statistical analysis of the impact of education in diabetes related oral health problems upon the clinical practice by the respondents was undertaken. A Pearson Chi-Square with Fisher's Exact Test analysis indicated that overall participants' levels of confidence to assess the oral signs and symptoms in people with diabetes was not significantly associated with their level of education (χ^2 [4, $n = 144$] = 6.479, $p = .144$). However, a very strong association was detected among the participants who undertook combined forms of diabetes related oral health education and an increased level of confidence to provide oral health information to patients (χ^2 [4, $n = 144$] = 21.737, $p = .000$).

The Mann-Whitney U Test indicated a significant difference ($U = 1361.500$, $z = -2.330$, $p = .020$) in participants' levels of confidence to assess oral health signs and symptoms between those who had (*Mean rank* = 76.73, $n = 111$) and had not (*Mean rank* = 58.26, $n = 33$) undertaken diabetes related oral health education. A statistically significant difference ($U = 929.500$, $z = -4.452$, $p = .000$) was also detected in the levels of confidence to provide diabetes related oral health information to patients,

between those who had undertaken education (*Mean rank = 80.63, n* = 111) and those who had not (*Mean rank = 45.17*, *n* = 33).

A further comparison, using the Pearson Chi-Square with Fisher's Exact Test, between the professional groups, detected a statistically significant association (χ^2 [4, *n* = 122] = 23.807, *p* = .000) between the category of diabetes educators who had undertaken education and their increased levels of confidence to provide diabetes related oral health information to patients. However, the association between the diabetes educators' levels of confidence to assess the oral health signs and symptoms in patients and the undertaking of education was found not to be statistically significant using Pearson Chi-Square with Fisher's Exact Test (χ^2 [4, *n* = 122] = 7.731, *p* = .080). No statistically significant associations were detected between the endocrinologists' and allied health professionals' levels of confidence to either assess their patients for oral health problems or, in their provision of diabetes related oral health information with the undertaking of diabetes related oral health education.

Table 4.10 shows the mean differences in levels of confidence to assess oral health signs and symptoms and provision of diabetes related oral health information to patients within the categories of endocrinologists, diabetes educators and allied health professionals, comparing those who had undertaken diabetes related oral health education, with those who had not. A Mann-Whitney U Test indicated a statistically significant difference (*U* = 896.000, *z* = -2.497, *p* = .013) in the levels of confidence to assess oral health signs and symptoms among the category of diabetes educators. This suggests those who had undertaken diabetes related oral health education scored higher (*Mean Rank = 65.57, n* = 95) than their colleagues who had not undertaken this education (*Mean Rank = 47.19, n* = 27). Even stronger evidence for a statistically significant difference (*U* = 558.000, *z* = -4.643, *p* = .000) in the levels of confidence to provide diabetes related oral health information to patients by the participants in the

diabetes educator category existed. The results show those diabetes educators who had undertaken diabetes related oral health education rated their confidence levels higher (*Mean Rank = 69.13, n* = 95) than their colleagues who had not undertaken this education (*Mean Rank = 34.67, n* = 27).

While both endocrinologist and allied health professionals who had undertaken diabetes related oral health education ranked higher in their levels of confidence to assess diabetes related oral health signs and symptoms, and to provide diabetes related oral health information, than their colleagues who had not undertaken this education, analysis of the differences within the Mann-Whitney U Test were not statistically significant. In addition, results indicate that endocrinologists felt more confident to assess their patients' signs and symptoms of oral health problems than to provide diabetes related oral health information, which is in contrast to results for both the diabetes educators and allied health professionals.

Table 4.10
Descriptive Statistics for Differences in Levels of Confidence to Assess Oral Health Signs and Symptoms, and Provide Diabetes Related Information Against Professional Category Education

Professional category Confidence items	Diabetes and oral health education						Mann-Whitney U Test	
	Yes			No				
	n	Mean	Mean Rank	*n*	Mean	Mean Rank	*Z**	Asymp. Sig* (two-tailed)
Endocrinologists								
Assessing oral health signs and symptoms	8	2.88	6.63	4	2.75	6.25	-0.176	0.860
Providing diabetes related oral health information	8	3.13	6.56	4	3.00	6.38	-0.087	0.930
Diabetes Educators								
Assessing oral health signs and symptoms	95	2.46	65.57	27	1.93	47.19	-2.497	0.013*
Providing diabetes related oral health information	95	3.11	69.13	27	2/04	34.67	-4.643	0.000*
Allied Health Processionals								
Assessing oral health signs and symptoms	8	2.25	5.88	2	1.50	4.00	-0.847	0.397
Providing diabetes related oral health information	8	3.38	6.00	2	2.50	3.50	-1.085	0.278

*Note. *p = <0 .05.*

DHPs' management of patients with varied levels of risk for oral health complications. The relationships between participants' knowledge and skills in managing patients who were considered at greater risk for oral health complications was explored using the Spearman's Rank-Order Correlation Test. The investigation of the participants' levels of agreement in recognising the potential for oral health problems within this patient population was considered an important indicator of their potential motivation to undertake additional management in the workplace. Furthermore, variables such as the level of likelihood to investigate patients' complaints, and the levels of confidence to assess the diabetes related oral health status was investigated.

There was a statistically significant correlation (r = -.269, p = .001) between the participants' levels of likelihood to investigate oral signs and symptoms in the patient who had signs of other diabetes related complications (retinopathy, nephropathy or neuropathy) and their levels of agreement with the questionnaire item, "The significance of an increased risk of oral health problems in the person with diabetes is *only* relevant *if* the patient has been diagnosed with another diabetes related complication". While this association is negative, the lower levels of agreement with the latter statement does indicate greater acknowledgement by participants of the increased risk for oral health problems in all people with diabetes. Therefore, the data suggests this is strongly associated with the increased levels of likelihood to investigate oral health problems in the patient who is at greater risk.

In addition, statistically significant positive correlations were found between the participants' likelihood to investigate patients with other diabetes related complications for signs and symptoms of dental problems and their levels of confidence to assess for oral signs and symptoms (r = .382, p = .000), and to provide diabetes related oral health information (r = .489, p = .000). These results indicate the participants' higher

scores for confidence in assessing oral signs and symptoms and provision of diabetes related oral health information were associated with the higher scores for likelihood to investigate oral signs and symptoms in the patient when other diabetes related complications exist.

The data also detected statistically significant negative correlations between the participants' levels of agreement in recognising the risk for oral health problems in the patient free from diabetes related complications and their levels of confidence to assess for oral health signs and symptoms (r = -.189, p = .024), along with the provision of diabetes related oral health information (r = -.241, p = .004) to these patients. The results indicate the participants' lower levels of agreement with the questionnaire item, "The significance of an increased risk of oral health problems in people with diabetes is *only* relevant *if* the patient has been diagnosed with another diabetes related complication" (indicating acknowledgement of the increased risk for oral health problems in all people with diabetes) was associated with the increased levels of confidence in assessing oral health signs and symptoms and provision of diabetes related oral health information to this group of patients also.

Frequency of diabetes related oral health screening within diabetes care management. Participants were asked to identify how often they would include assessment of oral health signs and symptoms within their screening for complications in persons with diabetes. Just over half (54.9%, n = 79) identified that they either did not routinely perform diabetes and oral health assessments, or they never performed this type of assessment as they considered it to be outside of their scope of practice. The remaining participants' responses (45.1%, n = 65) were relatively even in distribution across the remaining categories for screening frequency. The frequency and percentages for the responses are outlined in Table 4.11.

Table 4.11
Descriptive Statistics for the Frequency of Oral Health Screening in Diabetes Care

Frequency of oral health complications screening	Frequency	Percent
Never, it is not within my scope of practice to perform diabetes and oral health assessments	19	13.2
Each visit	15	10.4
Quarterly	7	4.9
Half yearly	10	6.9
Yearly	15	10.4
I do not routinely perform diabetes and oral health assessments	60	41.7
Other	18	12.5
Total	144	100.0

Of those responses obtained within the 'Other' screening category (12.5%, *n* = 18), the frequency of screening regimens have been arranged under predominant themes and are displayed in Appendix Q. Most notably within these, participants identified screening the patient on admission to their service, which in the majority of cases would be upon the diagnosis of diabetes, or as part of an ongoing diabetes self-management education programme as reflected in a participant's statement:

"At diagnosis and annually in non-complex type 2. As part of annual cycle of care for paediatric and transitioning adolescent and non-complex type 1. Each trimester during pregnancy and, biannually in complex type 2."

On the whole, screening of patients occurred on an *ad hoc* basis. This is reflected in the following participants' statements:

"This will vary from person to person. As part of the self-management education."

"Do not routinely include it. To identify the cause of hyperglycaemia, will then ask about the oral health care, admittedly this is still infrequent."

A Pearson Chi-Square analysis of the association between the frequency of oral health screening within the diabetes care regimen and the participants' levels of

confidence to assess the oral health signs and symptoms in the patient was undertaken. The data suggests the existence of a statistically significant association (χ^2 [24, n = 144] = 45.156, p = .006); however, a Fisher's Exact Test statistic was unable to be computed. Therefore, the data should be viewed with caution due to the small sample size across several of the data variables. The data indicated the DHPs' lower levels of confidence, 1 out of the possible score of 5, was strongly associated with the least frequent subscale item, 'Never, it is not within my scope of practice to perform diabetes and oral health assessments', and the score 2 out of 5, with the item 'I do not routinely perform diabetes and oral health assessments. In addition, the higher levels of confidence to assess oral signs and symptoms, 3 out of 5, were associated with the screening frequency subscale items 'Yearly' and 'At each visit'.

The Chi-Square Test for the association between frequency of the oral health screening within the diabetes care regimen and the participants' levels of confidence to provide diabetes related oral health information at this consultation suggested evidence of a statistically significant result (χ^2 [24, n = 144] = 43.533, p = .009). Again for the reasons of cell size and the inability to compute the Fisher's Exact Test statistic means this result should be viewed with caution. The data indicated that the lower levels of confidence to provide diabetes related oral health information, 2 out of 5, was strongly associated with the frequency subscale item 'I do not routinely perform diabetes and oral health assessments'. The higher levels of confidence, score 4 out of 5, were associated with both frequency subscale items, 'Each visit' and 'Half yearly' at consultation.

Oral health management practices undertaken in diabetes care. The 19 participants who indicated it was not within their scope of practice to perform diabetes and oral health complications exited the study at this point. A further nine participants failed to complete this part of the questionnaire. The participants who answered in an affirmative manner (n = 125) were asked to indicate the type of actions which they would include in their assessment of a patient with diabetes against a proposed set of activities. The greatest percentage of responses (81.4%) indicated recommending the patient seek a dentist/periodontitis appointment for assessment and care. Over three-fourths of the participants identified discussing risk-related behaviours. Slightly less than half of the participants either discussed preventative oral health care behaviours or referred the patient to a dentist if they perceived the need. The activity that participants included least was the specific diabetes and oral health risk assessment (8%). The frequency and percentage results are further detailed within Table 4.12

Table 4.12
Descriptive Statistics of Oral Health Assessment, Education and Referral Processes Undertaken by Participants in Practice

Oral health care activity	*n*	%
I recommend to the patient that they attend a dentist/periodontist appointment for assessment and care follow–up	92	81.4
Discuss risk-related behaviours and outcomes upon oral health e.g. poor oral hygiene, smoking and glycaemic control	77	68.1
Discuss preventative oral health care behaviour e.g. brushing, flossing and mouthwash use	45	39.8
I refer to a dentist/periodontist if I perceive the need	44	38.9
Routine oral health screening questions	30	26.5
Specific diabetes and oral health risk assessments	9	8.0

Circumstances prompting investigation of patients' oral health status. The circumstances in which participants would investigate the oral health status in a patient with diabetes were examined. The majority of participants (85%) indicated they would investigate the oral health status only when a specific oral health concern or complaint was identified by the patient. Just over half of the participants stated they would investigate when the patient was hyperglycaemic without an identified cause. The responses drawn were from a set of proposed circumstances, the results of which are provided in Table 4.13

Table 4.13
Circumstances Requiring Investigation of Oral Health Status in Patients

Reasons for investigation of oral health status	*n*	%
Only when a specific oral health concern or complaint is identified by the patient	96	85.0
When the patient is hyperglycaemic *without* identified cause	57	50.4
When referred by a dentist/periodontist	37	32.7
When the patient is pregnant *or* planning pregnancy	35	31.0
'Other' reasons	26	23.0
When the patient is hyperglycaemic *with* known cause	21	18.6

Given the diversity of clinical practice settings and patient populations served, an 'Other' option was offered to participants to enable a comprehensive capture of the clinical reasoning impacting upon service delivery. The 'Other' responses (n = 26) are categorised under predominant themes and described within Appendix R. The majority of responses indicated a broad spectrum of reasoning for investigation of oral health which was contained within the participants' existing diabetes service delivery model and largely dependent upon the initiative of the health professional as reflected in the following participants' statements:

"When newly referred to service, on their second visit or, if they have any complaints about their oral health."

"As part of an annual Team Care Arrangement referral process."

"General discussion of issues, but not investigated."

"Each person with diabetes, irrespective of glycaemic control or complications or if patient expressed concern."

Many participants identified more specific concerns for the patients' oral health as a trigger for further investigation such as:

"When I can see their teeth are in terrible condition during a conversation and when they ask about soft drinks."

"When the patient identifies issues with their ability to eat certain foods or other symptoms related to their teeth and gums."

Participants also identified concern for the impact of oral health complications upon the patients' other pre-existing medical conditions as a reason to investigate their oral health status, as reflected in the following participants' statements:

"When there is known cardiovascular disease."

"Pre-surgery especially cardiac or osteo surgical procedures."

"Obviously need to think about it in relation to all cases of hyperglycaemia, gastroparesis and gastric reflux."

"Those clients who take liquid meal replacements for weight loss."

Likelihood to investigate the oral health status in patients with oral complaints. The final question regarding specific management of diabetes and oral health complications in practice focused upon identifying the participants' likelihood of taking investigative action when consulting with a patient who had an oral health complaint. The participants (n = 113) were asked to indicate whether they took action, either affirmative or negative, against a set of proposed activities. An opportunity for participants to elaborate if they undertook different investigative activities in their practice was provided.

The greatest number of responses from participants indicated likelihood to question patients regarding: their glycaemic control (92.9%), the frequency of dental care visits (91.2%), referral to the dentist/periodontist (87.6%), and the frequency of personal dental care activity (78.8%). The actions that participants were least likely to undertake were the questioning of the patient regarding recent changes in taste sensations (29%) and changes to food choices in respect of flavours (27%). The frequency and percentages for participants' responses, both in the affirmative and negative, are detailed in Table 4.14.

Table 4.14
Descriptive Statistics for Participants Undertaking Oral Health Assessment Activity in Clinical Practice

Activity type	Activity undertaken			
	Yes		No	
	n	%	*n*	%
Inspection of the hard and soft tissues in the mouth cavity	65	57.5	48	42.5
Inspection of the teeth	58	51.3	55	48.7
Note number of teeth present or missing	49	43.4	64	56.6
Note presence of oral infections	90	79.6	23	20.4
Note presence of oral lesions	86	76.1	23	20.4
Document oral findings and diagnosis	74	65.5	39	34.5
Question patient regarding glycaemic control	105	92.9	8	7.1
Question patient regarding frequency of personal dental care activity	89	78.8	24	21.2
Question patient regarding frequency of dental care visits	103	91.2	10	8.8
Question patient regarding recent changes in taste sensation	29	25.7	84	74.3
Question patient regarding recent changes to food choices in respect of flavours	27	23.9	86	76.1
Question patient regarding oral medication intake	78	69.0	35	31.0
Question patient regarding level of hydration	82	72.6	31	27.4
Question patient regarding referral to dentist/periodontist	99	87.6	14	12.4
Other actions undertaken	23	15.0	130	85.0

The responses received within the 'Other actions undertaken' option were again categorised under predominant themes and are fully described within Appendix S. A large portion of the responses indicated questioning the patient further in regard to their medical history, i.e., whether a current smoker, a history of bulimia or induced vomiting, food allergies, dietary restriction, and therapies/medications the patient has utilised in an attempt to resolve the condition. Only two participants indicated they would provide the patient an educational resource on dental care.

Initial medical management was undertaken by one participant (an endocrine registrar) who identified the following:

"Prescribe antibiotics if needed, review insulin/medication doses and consider salivary replacement therapies."

However, the majority of responses identified referring the patient to either the General Practitioner and/or, where services were available, a dentist for management as reflected in the following participant's statement:

"If the problem is acute I would refer them to their GP for medical assessment. I would not do a detailed oral inspection/assessment but refer on to a Dentist/GP for this assessment and management."

A limitation in access to dental services was identified as an issue for DHPs within rural and remote locations. This required a different approach in participants' management in order to achieve appropriate patient care as reflected in the following statement:

"There is not a referral pathway in my area to refer to a Dentist or Periodontist; therefore, I would involve the GP in getting the referral done especially if the client has financial constraints."

Levels of concern for signs of oral health problems identified in patients with oral health complaints. Participants were asked to consider a practice scenario in which they were required to conduct an assessment of a patient's oral cavity following his/her complaint of oral health symptoms. Participants were asked to rate, on a scale of 1 to 5, their levels of concern for the presentation of signs and symptoms identified during this assessment. As shown in Table 4.15, the mean scores for each oral health complaint items were between 3.48 and 4.53. This indicated the participants' rated their levels of concern upon the Likert scale as predominately mid-scale, i.e., undecided whether they were concerned or not, or higher, indicating they were moderately concerned at their findings during the assessment.

Table 4.15
Descriptive Statistics for Participants' Level of Concern for Patients' Oral Health Complaint

Oral health complaint (n = 113)	Mean	SD	95% CI
Bleeding gums when brushing	3.97	0.949	[3.80, 4.15]
Loose teeth	4.31	0.917	[4.14, 4.48]
Changes in the way teeth fit together	3.90	1.110	[3.70, 4.11]
Pain when chewing	4.36	0.768	[4.22, 4.51]
Red, swollen or tender gums	4.53	0.682	[4.40, 4.66]
Noted halitosis or told by others of breath odour	4.13	8.81	[3.97, 4.30]
Tartar formation	3.48	1.053	[3.28, 3.67]

Impact of education in diabetes related oral health complications upon participants' levels of concern for patients' oral health complaints. The association between the participants' levels of concern, from a possible range of 1 to 5, for patients' complaints of oral health problems and the undertaking of education in diabetes related oral health complications was examined using the Chi-Square with Fisher's Exact Test. The associations of each subscale item with each of the educational forms, part of the professional course, attendance at a session or self-directed learning was undertaken. Statistically significant associations were detected between the category of self-directed learning and the oral health complaints of:

changes in the way teeth fit together (χ^2 [4, n = 112] = 12.266, p = 0.011); pain when chewing (χ^2 [3, n = 112] = 10.403, p = 0.009); red swollen or tender gums (χ^2 [3, n = 112] = 7.312, p = 0.038); noted halitosis or told by others of breath odour (χ^2 [3, n = 112] = 8.005, p = 0.038); and tartar formation (χ^2 [4, n = 112] = 10.725, p = 0.024).

Correlations between participants' levels of confidence to assess diabetes related oral health status and provide diabetes related oral health information, and the levels of concern for patients' oral health complaints. A Spearman's Rho Test for correlation was utilised to determine the relationships between the participants' levels of confidence to assess the oral signs and symptoms in patients, and provision of diabetes related oral health information, and the levels of concern participants had for the signs and symptoms noted at the consultation. The data indicated statistically significant positive relationships between the participants' rated levels of confidence to assess oral signs and symptoms and the levels of concern for patients' oral signs and symptoms of: bleeding gums when brushing (r = .246, p = .009); pain when chewing (r = .245, p = .009); red, swollen or tender gums (r = .287, p = .002); noted halitosis or told by others of breath odour (r = .250, p = .007); and tartar formation (r = .288, p = .002). This indicated the participants' levels of concern for patients' oral health complaints, with the exception of loose teeth, rose in relation to their increasing levels of confidence to assess the oral signs and symptoms in the person with diabetes. The data for the conditions of loose teeth and changes in the way teeth fit together did not meet statistical significance.

Significant positive relationships between the participants' levels of confidence to provide diabetes related oral health information and their levels of concern when the patient was identified as having the oral health signs and symptoms was evident for the complaints: bleeding gums when brushing (r = .270, p = .004); pain when chewing (r =

.274, p = .003); red swollen or tender gums (r = .219, p = .020); noted halitosis or told by others of breath odour (r = .323, p = .000), and tartar formation (r = .193, p = .041). This indicated the participants' levels of confidence to provide diabetes related oral health information rose in relation to their increasing levels of concern for these signs and symptoms of oral health problems when identified in the patient at the consultation. The data for the condition of loose teeth and changes in the way the teeth fit together, did not meet statistical significance.

Likelihood to recommend treatment options to patients with oral health complaints. Participants (n = 113) were presented with a further practice scenario in which the patient presented with xerostomia. Participants were asked to rate, on a scale of 1 to 5, their levels of likelihood of managing the problem by recommending treatment options. Table 4.16 provides the descriptive statistics against each of the treatment recommendation items, with the lower scores, less than 3, indicating the moderately low likelihood of recommending the restriction in the use of substances, caffeine and alcohol, which may accentuate dehydration in this individual. In addition, the recommendations for the use of treatments which may offer symptomatic relief, such as sugarless gums or mints, saliva substitutes, or fluoride mouthwashes, were also lower scoring.

In contrast, participants strongly endorsed (i.e. Likert score > 4), the recommendations that patients improve their glycaemic control and the need for review of their oral health status by both their GP and dentist/periodontist. Participants appeared most undecided (Likert score 3-4) whether to recommend to patients the options which included taking frequent sips of water and undergoing a medication review. This data suggest the DHPs are reticent to implement oral health knowledge

and provide information to patients that may have the potential to reduce the impact of xerostomia symptoms.

Table 4.16
Descriptive Statistics for Participants' Level of Likelihood to Recommend Treatment Options to Patients With Oral Health Complaints

Types of treatment recommendations *(n* = 113)	Mean	SD	95% CI
Use sugarless gum	2.86	1.445	[2.59, 3.13]
Use sugarless mints	2.37	1.344	[2.12, 2.62]
Take frequent sips of water or ice chips	3.63	1.241	[3.40, 3.86]
Restrict caffeine intake	2.50	1.296	[2.25, 2.74]
Restrict alcohol intake	2.80	1.304	[2.55, 3.04]
Rinse with fluoride mouthwashes	2.32	1.248	[2.09, 2.55]
Use saliva substitutes	2.70	1.457	[2.43, 2.97]
Improve glycaemic control	4.28	1.138	[4.07, 4.50]
Undergo medication review	3.88	1.148	[3.67, 4.10]
Referral to GP for review	4.22	0.924	[4.04, 4.40]
Referral to dentist/periodontist for review	4.17	1.141	[3.96, 4.38]

Impact of education in diabetes related oral health complications upon participants' levels of likelihood to recommend treatment options to patients with oral health complaints. The Chi-Square with Fisher's Exact Test detected statistically significant associations between those participants who had undertaken self-directed education in diabetes and oral health and the greater likelihood to recommend a selection of treatment options to the patient with a complaint of xerostomia. The treatment items found to be statistically significant were the use of sugarless gum (χ^2 [4, n = 112] = 23.642, p = 0.000); to take frequent sips of water or ice chips (χ^2 [4, n = 112] = 10.467, p = 0.030) and referral to their GP for review (χ^2 [4, n = 112] = 8.951, p = 0.039). No other statistically significant associations were found between the participants undertaking diabetes related oral health education either within the professional course or with their attendance at a session, and the likelihood to recommend treatment options to patients with the oral complaint of xerostomia.

Correlation between participants' levels of confidence to provide diabetes related oral health information and the levels of likelihood to recommend treatment options to patients with oral health complaints. A Spearman's Rho Test for correlation indicated statistically significant positive relationships between the participants' levels of confidence to provide diabetes related oral health information and the levels of likelihood to recommend a selection of treatment options to the patient with xerostomia. Those treatment options found to be statistically significant were the use of sugarless gum (r = .298, p = .001); use of saliva substitutes (r = .276, p = .003); restriction in caffeine intake (r = .300, p = .001); restriction in alcohol intake (r = .188, p = .046), along with the recommendation to undergo a medication review (r = .207 p = .028); referral to the GP for review (r = .223, p = .018); and referral to the dentist/periodontist for review (r = .224, p = .017). This indicated the participants' levels of likelihood to recommend the treatment options identified rose in relation to their levels of confidence to provide diabetes related oral health information to the person with diabetes.

Diabetes and oral health management of the patient from groups with more specific management needs or who are socially isolated. Nearly all of the participants (94.8%, n =145) identified working with patients who were from a range of groups with more complex diabetes education and management needs, or who were socially isolated thereby limiting their access to oral health services as previously identified in Table 4.5. An exploration of the associations between the variables, participants' 'levels of confidence to assess the oral health status'; 'levels of confidence to provide diabetes related oral health information'; 'levels of concern for patients oral signs and symptoms'; and 'levels of likelihood to recommend treatment

options' when the participants worked with the specified groups of patients, was undertaken.

A Pearson Chi-Square with Fisher's Exact Test did not detect a statistically significant association between the participants who worked with patients with more specific needs or who were isolated and the participants' levels of confidence to assess oral health signs and symptoms (χ^2 [4, n = 142]) = 5.071, p = .202) , nor with their levels of confidence to provide diabetes related oral health information (χ^2 [4, n = 142] = 4.694, p = .207), nor with their levels of likelihood to recommend any treatment option from the range described in Table 4.16.

The data were examined for associations between the participants who worked with the specific needs or isolated patients, and their levels of concern for the oral signs and symptoms identified in this patient. Statistically significant relationships existed for the complaints; changes in the way the teeth fit together (χ^2 [4, n = 112] = 9.135, p = .012), and pain on chewing (χ^2 [4, n = 112] = 9.913, p = .007).

Differences in management of diabetes related oral health complications between patients with varied levels of need. The differences between variables: participants' 'levels of confidence to assess oral health signs and symptoms', 'levels of confidence to provide diabetes related oral health information', and the 'levels of concern for the patients' oral signs and symptoms' for those participants who worked with patients who had more specific needs or who were isolated, compared to those participants who did not work with these patient groups, were analysed using the Mann-Whitney U Test. Results of the tests between participant groups for the variables; 'levels of confidence to assess oral health signs and symptoms' and 'levels of confidence to provide diabetes related oral health information' are detailed in Table 4.17.

Statistically significant differences were found between those participants who either work with, or who do not work with patients who had more specific needs or who were isolated, and their levels of concern for patients' oral health complaints. The descriptive statistics for the differences in participants' levels of concern for each oral health sign and symptom item, detected in patients, are detailed in Table 4.18.

Table 4.17

Descriptive Statistics for Participants' Levels of Confidence in Oral Health Practice Between Those Participants who Work/Do Not Work With Patients who had More Specific Needs or who Were Isolated

Confidence item	Work with specific or isolated groups					
	Yes (*n* = 137)		No (*n* = 5)		Mann-Whitney U test	
	Mean	Mean Rank	Mean	Mean Rank	*Z**	Asymp. Sig * (two-tailed)
Levels of confidence to assess oral signs and symptoms	2.41	72.27	1.80	50.40	-1.218	0.223
Levels of confidence to provide diabetes related oral health information	2.94	72.04	2.60	56.70	-0.851	0.395

*Note. *p = <0 .05*

Table 4.18

Descriptive Statistics for Participants' Levels of Concern for Patients Oral Health Signs and Symptoms Between Those Participants who Work/Do Not Work With Patients who had More Specific Needs or who Were Isolated

Patient complaints	Work with specific or isolated groups					
	Yes (*n* = 109)		No (*n* = 3)		Mann-Whitney U test	
	Mean	Mean Rank	Mean	Mean Rank	*Z**	Asymp. Sig * (two-tailed)
Bleeding gums when brushing	3.98	57.13	3.33	33.67	-.1.298	0.194
Loose teeth	4.34	57.15	3.33	33.00	-1.407	0.159
Changes in the way teeth fit together	3.95	57.72	2.00	12.33	-2.504	0.012*
Pain when chewing	4.40	57.63	3.00	15.33	-2.464	0.014*
Red, swollen or tender gums	4.54	56.87	4.33	43.00	-0.853	0.394
Noted halitosis or told by others of breath odour	4.17	57.33	3.33	26.50	-1.731	0.084
Tartar formation	3.50	56.92	3.00	41.33	-0.853	0.394

*Note. *p = <0 .05*

The differences in participants' levels of likelihood to recommend treatment option to patients when they worked with special needs or isolated compared to their colleagues who did not, was ascertained. A Mann-Whitney U Test indicated a statistically significant difference in the participants' levels of likelihood to recommend that the patients improve their glycaemic control (U = 66.500, z = -2.01, p = .044). The score for this subscale item was higher for the participants who worked with special needs and isolated patients was higher (*Mean rank* = 84.17) than those scored by participants who did not see patients in this category (*Mean rank* = 24.17). The descriptive statistics for the differences in the levels of likelihood to recommend treatment between participants who worked with special needs and isolated patients versus those participants who did not, are outlined in Table 4.19.

Table 4.19
Descriptive Statistics for Participants' Levels of Likelihood to Recommend Treatment Options to Patients Between Those Participants who Work/Do Not Work With Patients who had More Specific Needs or who Were Isolated

Types of treatment recommendations	Work with specific needs or isolated groups				Mann-Whitney U test	
	Yes (n = 109)		No (n = 3)			
	Mean	Mean Rank	Mean	Mean Rank	Z*	Asymp. Sig** (two-tailed)
Use sugarless gum	2.85	56.58	2.67	53.50	-0.166	0.868
Use sugarless mints	2.38	56.88	1.67	42.67	-0.776	0.438
Take frequent sips of water or ice chips	3.64	57.12	3.00	34.00	-1.257	0.209
Restrict caffeine intake	2.52	57.05	1.67	36.67	-1.257	0.270
Restrict alcohol intake	2.83	57.29	1.67	27.83	-1.587	0.113
Rinse with fluoride mouthwashes	2.34	56.90	1.67	42.00	-0.812	0.417
Use saliva substitutes	2.68	55.74	4.00	84.17	-1.535	0.125
Improve glycaemic control	4.31	84.17	3.33	24.17	-2.011	0.044*
Undergo medication review	3.92	57.05	3.00	36.50	-1.134	0.257
Referral to GP for review	4.25	57.18	3.67	31.67	-1.466	0.143
Referral to dentist / periodontist for review	4.20	56.89	3.67	42.50	-0.840	0.401

Note. *p = < .05.

Perception of responsibility for professional role in diabetes related oral health assessment and management

In order to ascertain the DHPs' perceptions of responsibility for oral health care in people with diabetes, participants (n = 144) were asked to consider the provision of assessment and management of diabetes related oral health care and to identify the health professionals they considered had a role in the care. The individual responses were categorised into professional groups and are displayed in Table 4.20, with the frequencies against each individual health professional identified within Appendix T. While the largest count is attributed to dental health professionals (n =152), the second largest count (n = 130) indicates the existence of the perception among the participants that DHPs have a major role in the assessment and management of diabetes related oral health care within their patient population.

Table 4.20
Participants' Responses Identifying the Health Professionals Having a Role in Diabetes Related Oral Health Care

Health professional type	Frequency
Dental professionals	152
DHP	130
Primary care setting health professionals	86
Allied health professionals	34
Other health professionals	15

Driving forces in management of diabetes and oral health complications

In relation to the third objective of this study, participants were asked to identify those factors which they believed influenced their ability to improve the diabetes related oral health care for patients who they managed. The availability of diabetes and oral care literature for patients was considered to be highly influential by 91% (n = 131) of participants. More than 80% indicated that further professional development and availability of clinical practice guidelines for diabetes and oral health care was also a factor. Provision of pamphlets outlining oral health service information to patients,

and a greater access to dental service especially within the Medicare health system was chosen by more than two-thirds of the participants. Greater than 50% of participants identified streamlined referral processes and multidisciplinary team care arrangements as a driving force.

While 8.3% (n =12) participants chose to identify 'Other' factors these were overwhelmingly related to issues of oral health service delivery. Despite the increasing use of computer technology in healthcare, a low number (5.6%, n = 8) of participants indicated that use of an 'on-line' chat group would be influential in improving their practice. A minority of participants 3.5% (n =5) identified their scope of practice limitation meant they were unable to identify a factor that would positively influence the implementation of diabetes and oral health complications. The frequency and percentage rates of responses against the set of proposed factors are identified in Table 4.21. The individual responses received within the 'Other' category were grouped under predominant themes within Appendix U.

Table 4.21
Descriptive Statistics of Positive Influences upon Participants' Ability to Improve Care

Factors improving management	Frequency	Percent
'Diabetes and oral health care' education pamphlets for patients	131	91.0
Diabetes and oral health care clinical practice guidelines	121	84.0
Further diabetes and oral health care professional development	117	81.2
Greater access to dental services	111	77.1
'Oral health care services' information pamphlets for patients	101	70.1
Medicare item provision	95	66.0
Multidisciplinary team care arrangements	89	61.8
Streamlined referral processes	83	57.6
Other factors	12	8.3
On-line chat group	8	5.6
None, I consider it outside my professional scope of practice	5	3.5

Restraining forces in managing diabetes and oral health complications

Further questioning of participants (*n* = 142*)* concentrated upon the existence of barriers to the provision of diabetes related oral health care to patients within the clinical setting. Again participants were offered a set of proposed factors. Two-thirds (64.1%) identified a lack of access to dental services as the greatest barrier.

Approximately 60% of participants identified the lack of clinical practice guidelines and the lack of knowledge of diabetes and oral health issues as restraining forces in their management. The lack of referral processes and the lack of time to include oral health issues in the management of diabetes accounted for one third of responses against the perception of barriers.

The lack of recognition for the DHPs' role in oral health education, and for those with a Medicare provider number in private practice, the lack of reimbursement for the time required for management were identified by over 20% of participants. Furthermore, 9.2% (*n* = 13) of participants identified diabetes related oral health care was not within their scope of practice as a DHP. The frequency and percentage rates are presented in Table 4.22

Table 4.22
Descriptive Statistics of Barriers to Diabetes and Oral Health Complication Management

Factors restraining management (n = 142)	Frequency	Percent
Lack of access to dental services	91	64.1
Lack of clinical practice guidelines	85	59.9
Lack of knowledge of diabetes and oral health issues	81	57.0
Lack of referral processes	53	37.3
Lack of time to include oral health issues in my management of diabetes	51	35.9
Lack of recognition of my role in diabetes and oral health education	39	27.5
Lack of reimbursement for management time required	29	20.4
Other factors	17	12.0
Not in my professional scope of practice	13	9.2

A further 12% of responses were included within an 'Other' category which aimed to capture the individual responses which may have fallen outside of the choices offered. These have been categorised under themes and are displayed in Appendix V. In the main the responses received reflect those within the prior category of proposed barriers. These included lack of, or limitation in accessing appropriate and affordable oral health services, lack of educational resources and clinical practice guidelines. In addition scope of practice issues such as the lack of acceptance by the DHP, of their role in oral health assessment and management, a lack of diabetes related oral health knowledge, and the lack of appropriate equipment to facilitate oral health screening within their practice setting, was identified. Management is further impeded by a proportion of the patient population who had a limited perception of not only the need for an appropriate level of preventative oral hygiene self-care and dental maintenance, but also the need to identify the existence of an oral health problem to the DHP managing their care.

Chapter Summary

This chapter has reported the analysis of the survey responses achieved within this descriptive study. The three main study objectives were to:

1. Assess Australian DHPs' levels of knowledge of oral health issues which impact upon the person with diabetes.
2. Determine the DHPs' scope of practice regarding intervention, health promotion and care management of oral health issues in persons with diabetes.
3. Identify the restraining and driving forces that influence the provision of oral health care prevention and intervention for people with diabetes.

In addition, this study has identified the socio-demographic characteristics of the participants, their qualifications, experience, workplace settings and, their role which is

primarily to manage the care of people of any age living with one of the four types of diabetes mellitus in the varied communities within the Australian continent. The results have identified the associations, relationships and differences in the DHPs' receipt of education in diabetes related oral health complications and, the transformation of that knowledge into application of skills across the varied clinical settings. The clinical management of oral health complications within diabetes care has been shown to be related to the levels of confidence to assess oral health signs and symptoms, and provide diabetes related oral health information. Furthermore, this is in combination with the DHPs' perception of increased levels of risk for oral health complications and the need for frequent surveillance and care recommendations to the people living with diabetes.

The characteristics of the varied diabetes patient population and clinical settings appear to be factors influencing the DHPs' levels of likelihood to investigate, concern for verbalised complaints or identified signs and symptoms of oral health complications, and the likelihood to recommend treatment options to the person living with diabetes. Participants were able to identify the major driving and restraining factors which further manipulates their clinical practice in the area of diabetes and oral health management. The results of the data analysis included within this chapter are elaborated within Chapter Five

Chapter 5: Discussion of the results

This study explored the Australian DHPs' knowledge and management of oral health complications in people living with diabetes. The need for this study was based upon the paucity of information which identified the need for considered clinical management of oral health complications within the more specialised area of diabetes care. Furthermore, a gap in practice by Australian DHPs was anticipated given the lack of specific guidelines for oral complication screening as part of routine care, along with the absence of quality improvement initiatives targeting practice interventions by diabetes care team members. With the limited empirical evidence related to diabetes and oral health complications, this descriptive, cross-sectional study was specifically designed to:

1. Assess Australian DHPs' level of knowledge of oral health issues which impact upon the person with diabetes.
2. Determine the DHPs' scope of practice regarding intervention, health promotion and care management of oral health issues in persons with diabetes.
3. Identify the restraining and driving forces that influence the provision of oral health care prevention and intervention for people with diabetes.

This final chapter discusses the study's findings by relating them to available literature on diabetes and oral health complications, the various guidelines for the management of diabetes care by diabetes type, patient age, and the health policies which support chronic disease management in Australia. The limitations of this current study are also discussed, along with recommendations for future diabetes-specific oral health clinical practice and research.

Australian DHPs' level of knowledge of oral health issues which impact upon the person with diabetes

This study is the first which specifically identifies the Australian DHPs' level of knowledge of oral health complications in people living with diabetes. The findings indicate that the majority of DHPs do possess knowledge of the more common oral health complications that may develop, and may potentially identify these in patients during consultation. The DHPs do not however; appear to be able to recognise the association of the more obscure signs and symptoms of oral complications. As such they may not correctly identify the conditions in patients under their care.

The relevance of this new knowledge for future diabetes management is that it highlights the need for diabetes related oral health clinical guidelines which are currently lacking within Australian diabetes care. These guidelines should include a screening tool to direct and focus the DHPs' attention towards appropriate questioning of patients' oral self-care activities and the occurrence of oral symptoms. In addition, the targeted inspection of the oral cavity and documentation of the oral assessment, in conjunction with the medical history and diabetes management strategies, would assist in identifying those individuals who have evidence of, or are at greater risk of diabetes related oral health complications. This data in turn would provide much needed evidence showing the incidence and prevalence of oral health complications in people with diabetes within Australia. To date this is sadly lacking.

The data suggests DHPs' knowledge base of oral health is limited. This is most likely related to the limited promotion of diabetes associated oral health complications within the Australian medical, nursing and allied health professional curricula. It would appear that this restriction also occurs outside of Australia. At a recent New York Academy of Sciences symposium entitled 'Diabetes and Oral Disease: Implications for Health Professionals', Lalla (Albert et al., 2012) reported that within

the US, “evidence to date suggested that physicians and nurses do not receive adequate training in oral health” (p.10). In the current study, receipt of education in diabetes associated oral health complications amongst the DHPs varied significantly. Similarly Australian DHPs do not receive adequate education and training to manage oral health complications within diabetes care. The data indicates the inclusion of oral health information within the formal curriculum is inconsistent and confirms a lack of recognition for, and impact of oral health complications within diabetes care at a fundamental management level.

The differences in health professionals’ knowledge with attendance at an education session or their undertaking of self-directed learning were not statistically significant. The small sample sizes obtained within the categories of endocrinologists and allied health professionals resulted in a non-normal distribution of these variables, and influenced the use of non-parametric tests in the analysis. This may have resulted in a loss of power, and therefore the ability to detect a statistical difference resulting in a type II error in the analysis of this data.

The educational sessions on diabetes and oral health complications, that DHPs attended, were predominately provided by a professional association. This was greater than that provided within the workplace as an in-service session or other opportunities for information arising from attendance at a university lecture, industry sponsored seminars or information from a dental company representative. The data indicates that the educational format offered by the diabetes professional associations (the ADS and ADEA) is highly effective in disseminating information to the majority of DHPs within Australia. These educational characteristics are clinically important within a quality improvement framework. The lack of diabetes related oral health education and training provision could be addressed by the targeting of educational activities

within the setting of the ADS and ADEA National and State branch conferences and meetings.

Self-directed learning was reportedly undertaken by one-third of DHPs, who utilised journals, and to a lesser extent, web-based instructional modules, core textbooks or a combination of all/most of these as resources. A smaller proportion sought individual methods to gain information. The fact that Australian DHPs utilise journals as their primary source of material for self-directed learning in diabetes and oral health complications is a matter for concern. Current research in diabetes related oral heath complications has a low profile within medical and nursing journals and core curriculum textbooks. Unless the DHP is proactive in searching the publication databases, more specifically pertaining to the dental profession, limited information is likely to be found. This may inadvertently leave the DHP mistaken in the belief that oral health problems do not require management in people living with diabetes.

Within this current study, the association of DHPs who undertook combined forms of education with their ability to correctly identify diabetes with a range of diabetes related oral conditions was statistically significant for the condition of candidiasis alone. Furthermore, the association of self-directed learning with their ability to recognise diabetes with the conditions: stomatopyrosis, candidiasis, and dental caries were also statistically significant. It is acknowledged that sample size may have biased the ability to detect statistically significant data results across the remaining oral conditions, despite the use of Fisher's Exact Test for small sample size during the Chi-Square analysis. This is most evident across the following variables: DHP categories in conjunction with the diabetes and oral health education, and DHPs' knowledge of diabetes association with each of the oral health complaints. Additionally, it may be argued the lack of significant results across the remaining oral health conditions

indicates the DHPs, irrespective of the undertaking of education, are able to deduce an association as a result of knowledge gained from extensive clinical experience.

Alternatively, the lack of statistical significance may relate to widespread lack of knowledge of oral health complications across the Australian DHP categories. This may be a reflection of the limited attention accorded to it within professional course material and diabetes-specific medical literature. Thus, the data results from this current study support the view expressed by Lamster (Albert et al., 2012) that while wide dissemination of literature pertaining to periodontal disease associated with diabetes has occurred, less attention has focussed on the other oral complications of diabetes.

Overwhelmingly DHPs within this study acknowledged the significance of an increased risk of oral health problems in the person living with diabetes. This is despite the absence of evidence which indicates the presence of other diabetes related complications. This indicates that DHPs are aware of the potential for oral health complications within the clinical practice setting. As the DHPs' level of agreement was towards one end of the Likert scale, which indicated a tendency to strongly agree, the result suggests DHPs may be influenced by past clinical experience rather than previous education in oral health. One possible explanation is that Australian DHPs frequently witness the impact of other diabetes related complications within their patient population, thus facilitating experiential knowledge. In addition, the knowledge of complication risk factors gained from large scale diabetes studies, such as the UKPDS and DCCT, is promoted within post-graduate diabetes course materials and underpins DHP clinical practice guidelines. This collective knowledge potentially enables the deduction of an increased risk of oral health complications, especially when the patient has had a longer duration of diabetes with 'less than ideal' glycaemic control.

Diabetes and oral health complications: DHPs' scope of practice and efficacy

Educational impact upon the levels of confidence and scope of practice. The current study proposed that a gap existed in the Australian DHPs' scope of practice regarding intervention, health promotion and care management of oral health issues in people living with diabetes. This was based upon the lack of specific guidelines which encompass oral health complication screening within diabetes management. Lalla (Albert et al., 2012) reported that physicians and nurses in the US were, from the evidence to date, not only uncomfortable performing a simple periodontal examination, but also rarely advised patients regarding the various aspects of oral health. This current study has provided empirical evidence to confirm there is indeed a gap in the management of oral health complications that can occur in people living with diabetes within Australia. The Australian DHPs' scope of practice is not only related to their knowledge base, but also their levels of confidence to assess oral health signs and symptoms, and to provide diabetes related oral health information to the patients they see.

Correspondingly, Australian DHPs within this current study perceived low levels of confidence to undertake an assessment of oral health signs or symptoms (mean 2.37, 95% CI 2.20, 2.54) and provide diabetes related oral health information (mean 2.91, 95% CI 2.73, 3.08) to the patients at a consultation. Additionally DHPs indicated a slightly higher level of confidence to provide information to the patient than their level of likelihood to investigate the complaints of dental problems if the patient had other complications related to their diabetes (mean 2.83, 95% CI 2.62, 3.05). It is not unreasonable to expect the levels of confidence in oral health practices would increase in relation to the DHPs' years of experience in diabetes care. However, there was no evidence of a statistically significant relationship between those DHPs who worked

solely in diabetes care and their years of clinical experience to support this expectation, and as such may be an area for future investigation.

The undertaking of education had a positive impact upon DHPs' levels of confidence to assess oral signs and symptoms, and to provide oral health information to the person living with diabetes, as observed in the statistically significant differences within the Mann-Whitney U Test. Likewise, the undertaking of education (combined forms) and the increase in the levels of confidence to provide information to their patients was strongly associated and statistically significant.

There is an absence of previous studies investigating DHPs' knowledge of oral health complications with which to compare these results. The current data appears to corroborate in the Australian context what was reported by Lalla (Albert et al., 2012) in the US, that there is an association between the health professionals' lack of knowledge of diabetes related oral complications and their confidence to undertake oral health screening and provide oral health information to people living with diabetes at a consultation.

Of concern is the lack of statistical significance for the association of Australian DHPs undertaking education with their level of confidence to assess the oral signs and symptoms in the person living with diabetes. While the statistics may be biased by small sample size, an effort to address this was undertaken with the use of the Fisher's Exact Test within the Chi-Square analysis. Alternatively, the overall statistic achieved may indicate the provision of education alone does not translate into the DHPs' increased level of confidence to assess the patient in clinical practice.

It may be argued that historically the separation of the fields of professional practice: dentistry from medicine, nursing and allied health care has had a negative impact upon the Australian DHPs. The separation has restricted the DHPs' ability to acquire oral health knowledge and skills, and thus their likelihood and confidence to

undertake practice in this area. While there is an expectation that DHPs' educational curricula and key resources, such as journals, would comprehensively cover diabetes related complications, the lack of attention towards the evidence-based oral health issues is most evident.

In addition, there is a lack of attention to the mastery of diabetes and oral cavity assessment skills, and implementation of practice guidelines within diabetes services. This is contrary to the current screening practices for other complications within diabetes care, such as the neurovascular foot assessment of people with diabetes. It is plausible therefore, that Australian DHPs perceive that the undertaking of oral health assessments as part of their service delivery is outside of their scope of practice. Indeed, within this current study 13.2% of DHPs identified they would never undertake an oral assessment as they perceived it was outside of their scope of practice.

This is a matter for clinical concern. The DHPs are in a prime position to effect positive change in outcomes for people living with diabetes, especially those who are at significant risk of diabetes related oral health complications. A risk, which is not unlike other complications associated with diabetes, related to the duration of the hyperglycaemic challenge and the bi-directional impact of physical, social and psychological factors complicating the diabetes management. The acquisition of skills in assessment and management of diabetes related oral health complications may translate into increased activity by DHPs in this area. It does therefore, deserves much greater attention than it currently receives both within health professional curricula and the clinical practice setting.

DHPs' management of patients with varied levels of risk of oral health complications. This study revealed Australian DHPs highly acknowledge the increased risk of oral health problems in people living with diabetes. Furthermore, this acknowledgement was found to be strongly associated with an increased level of likelihood to investigate oral health problems when the DHPs considered the patients to be at greater risk. In addition the DHPs' higher scores for confidence in assessment and provision of information were associated with the higher scores for likelihood to investigate the oral health status when other diabetes related complications existed.

This is clinically important. Currently there is no provision for DHP assessment of oral health complications within the diabetes complication screening regimen in Australia. While DHPs indicated low levels of confidence in diabetes related oral health practices, as shown in the mean scores, it appears that current management practices do not take into account the clinical indicators of the presence of an inflammatory process or other diabetes related complications that may exist. Thus it would appear there is neglect of evidence from previous research studies that have shown the inflammatory process associated with oral infections are not dissimilar to those of other diabetes related complications (Salvi et al, 1997; Southerland, Taylor & Offenbacher, 2005). This is in addition to research showing the greater prevalence of oral health complications being confirmed in individuals with diabetes who also experience other complications of diabetes, i.e., retinopathy, nephropathy, and cardiovascular disease (Southerland, Taylor, Moss, Beck & Offenbacher, 2006). Encouragingly, this current study data suggests there is the potential for the uptake of oral health management in diabetes care, and provides a level of evidence to support a call for the implementation of oral health screening within diabetes management.

Within this study, DHPs identified working with patients who were adults (96.8%), adolescents (75.2%), and paediatrics (35.9%). This indicates there is a

substantial proportion of patients who may, as previous research indicates, be at greater risk of oral complications, as they live with diabetes for an extended period of time with potentially limited control of their glucose levels (Kapellas & Slade, (2008). In addition the DHPs may have identified a proportion of the same individuals as belonging within a specific group of patients. These groups may have more specialised diabetes education and management needs due to their age, ethnicity, culture, disability, medical condition/s or who otherwise, due to social circumstances, were limited in their access to oral health services. The groups identified within this study were pregnant women, physically and intellectually disabled, Aboriginal and Torres Strait Islander people, other clients from culturally and linguistically diverse backgrounds, residential aged care clients, clients within secure facilities, or patients living in rural and/or remote communities.

These groups of individuals were, for the purposes of this current study, considered vulnerable for the development of oral health complications related to the complexity of issues in managing their glucose levels and oral care needs. This view is reflected by Loeppky and Sigal (2007) who identified individuals who were most in need for meticulous oral hygiene as those "with physical, developmental, mental, sensory, behavioural, cognitive or emotional impairment or a condition that requires medical management, health care interventions or use of specialised services or programs" (p. 915).

The Australian DHPs' management of diabetes related oral health complications in patients with specific needs did not appear significantly different to the care provided for the remainder of patients with diabetes who they consulted. While DHPs indicated higher levels of confidence to assess and provide information to the patient when they were from a specific needs group, as opposed to those who were not, the differences between the groups were not statistically significant. However, the

differences in the DHPs' level of concern for the oral signs and symptoms, changes in the way teeth fit together, and pain when chewing, were statistically significant.

The data suggests DHPs perceive these complaints as being more serious in patients with specific needs. Furthermore, DHPs identified an increased likelihood of recommending treatment options to manage xerostomia, with the exception of the recommendation to use salivary substitutes, when the participants worked with patients they considered belonged within a specific needs group.

It is plausible that the lower levels in likelihood to recommend the use of salivary substitutes to patients with specific needs is related to the perceived appropriateness of the treatment. Language and cultural differences, pregnancy, ageing and disability are factors that would be considered in ensuring patient safety with self-medication, which may influence the recommendation of this treatment. In addition salivary substitutes may not be appropriate if supplies are difficult to acquire in rural/remote locations. Conversely, the DHPs may not fully appreciate the impact of long term xerostomia and the relief that salivary substitutes may offer their patient. These findings may support those from a study of oral health care practices within a sample of US hospital-based neuroscience nurses. Cohn and Fulton (2006) found the lack of salivary substitute use was related to the personal preferences of staff, with the product features not always matched to the patient care needs.

The differences in DHPs treatment recommendation, between the groups of patients who were considered having specific needs and those who were not, were with the exception of improving the glycaemic control, not statistically significant. This suggests the DHPs were more aware of the need to manage the glycaemic levels in patients with specific needs and were actively promoting diabetes management in the context of the managing the xerostomia condition.

There is an absence of past studies investigating the DHPs' levels of agreement in oral health risk recognition, and their likelihood and confidence to undertake oral health activities within the varied diabetes patient demographic with which to compare results. Additionally, there is a lack of published data regarding Australian service delivery for people living with diabetes who are considered 'special needs'. It has, however, been estimated by the National Advisory Committee on Oral Health (2004) that approximately one million people would qualify within the special care category as a result of their disability or the complexity of oral health care needs.

Notwithstanding, evidence from previous dental research clearly identifies there is a need for enhanced oral health management in people who are at greatest risk and that early clinical intervention positively impacts upon individuals' quality of life, glycaemic control and overall ability to self-manage their diabetes. This study, therefore, provides a level of evidence to support the call for implementation of diabetes related oral health screening guidelines to address this area of need, especially in patients with more specific needs.

Initiation and frequency of diabetes related oral health screening within diabetes management. Within this current study, the majority of DHPs reported undertaking an investigation of a patient's oral health status prompted by a specific oral health concern or complaint. Other predominant triggers were hyperglycaemia without an identified cause, and pregnancy or pregnancy planning. While less than one-quarter of the DHPs provided 'Other' reasons for investigation, the specific cause appeared largely dependent upon the initiative of the DHP and the existing service delivery model in which the DHP worked.

However, less than half of the DHPs reported undertaking screening for oral health signs and symptoms as part of their diabetes related complications management.

The screening was performed either at the time of the individual's admission to the diabetes service which in the majority of cases would be upon the diagnosis of diabetes, or as part of an ongoing diabetes self-management education programme. DHPs otherwise reported screening occurred in an *ad hoc* manner.

It would appear that the diversity of DHPs employment settings, across the range of Government and non-Government agencies, i.e., hospital and correctional facilities, community health centres, Aboriginal communities, and in community based private practice, had a significant impact upon their diabetes related oral health screening practices. The Australian health system is complex given the array of funding and regulatory mechanisms across the multitude of public and private service providers (AIHW, 2010a). The fragmentation of funding and responsibility for service delivery across Commonwealth and State/Territory Governments results in varied models of care, and levels of resources within the workplace. These limitations are more prevalent in rural and remote areas (Britt et al., 2011a). Given these constraints, it is plausible that DHPs prioritise their service delivery to target issues that are assessed as most urgent and significant for the patient in their diabetes self-management. Thus, if DHPs do not screen for and identify oral health complications at his point, attention towards the patient's oral health status may not occur until a much later point in care, if at all.

Furthermore, the absence of sufficient funding for personnel may be a factor impeding the DHPs' ability to both initiate and maintain continuity of a diabetes related oral health service. However, the current absence of a clinical practice guideline and oral health screening tool does leads one to question the efficacy of the current practices reported by DHPs, to detect and manage oral health complications.

The associations between the DHPs' frequency of oral health screening and their levels of confidence to both assess and provide information to the patient were

statistically significant. As there is little support for oral health screening within diabetes management, the results which showed DHPs' lower levels of confidence to assess oral signs and symptoms being strongly associated with the least frequent screening items, 'Never, it is not within my scope of practice to perform diabetes and oral health assessments' or the item 'I do not routinely perform diabetes and oral health assessments' is not unexpected. Similarly the DHPs' lower levels of confidence to provide information was strongly associated with the item 'I do not routinely perform diabetes and oral health assessments'. This data does appear to confirm, within the Australian context, a trend identified in the US by Lalla (Albert et al., 2012) that health professionals feel uncomfortable performing a simple periodontal examination; rarely advising patients regarding the various aspects of oral health.

This study has provided empirical evidence of the need for a substantial increase in the provision of diabetes related oral health education and training to DHPs to achieve higher levels of confidence in practice within the DHP community. In addition, it highlights a need for diabetes-specific oral health clinical practice guidelines for patient screening. Indeed, this screening should occur at the time of the patient's admission to the diabetes service, as well as part of the annual cycle of complication screening. This would allow for targeted management strategies when oral complications are detected. Evidence suggests that pre-intervention assessment can reduce both the incidence and severity of oral complications (Miller & Kearney, 2001).

DHPs' level of concern for oral complaints. Australian DHPs reported their mean level of concern across the range of oral signs and symptoms indicative of the conditions gingivitis and periodontitis as being between 3.48 and 4.52 (out of a possible Likert score 1 to 5). DHPs identified lower levels of concern for evidence of

tartar formation, changes in the way teeth fit together, and bleeding gums. This data suggest DHPs view these conditions, on a scale of severity, as a lesser oral health condition potentially related to a lack of preventative dental care, or minor trauma. Whereas patients' complaints of pain when chewing; red, swollen or tender gums; noted halitosis or told by others of breath odour; and loose teeth elicited slightly higher levels of concern in the DHPs. This data suggests the DHPs do recognise these oral conditions as indicators of a more extensive disease process occurring within the patient.

Analysis of the associations between the undertaking of diabetes and oral health education indicated those DHPs who undertook self-directed learning were the most concerned for the patients' complaints of the questioned oral conditions with the exception of bleeding gums when brushing, and loose teeth. The reason for these two oral conditions not meeting statistical significance is unclear. It is plausible that the DHPs recognise the severity of these oral complaints and justifiably have moderately high levels of concern when the symptoms are reported by the patient, independent of the DHPs undertaking diabetes related oral health education.

Furthermore, the inability to achieve statistically significant data results across the remaining DHPs educational categories may be influenced to a greater extent by factors such as the level of concern and motivation, rather than sample size alone. It is also not unreasonable to suspect the motivation to undertake self-directed diabetes related oral health education is indicative of a higher level of concern for oral health complications. This is in contrast to those health professionals who, as part of their role, have been required to attend an education session or have received education as part of their professional course. As there is a lack of previous studies investigating DHP practices in oral health complications, with which to compare results, it would appear a valid topic for future research.

The correlations between the Australian DHPs' levels of confidence to assess oral health and their levels of concern at the patients' oral signs and symptoms were statistically significant for all but one: the complaint of loose teeth. In addition, the correlations between the DHPs' levels of confidence to provide oral health information and their levels of concern when an oral condition was identified (either patient self-reported or DHP identified) was again statistically significant for all but two: complaints of loose teeth, and the way the teeth fit together.

It would appear that other variables may be confounding these relationships. It is conceivable that the DHPs' oral health attitudes and beliefs influence their judgement of the patients' oral health care, especially when a state of poor dentition is identified. Furthermore, judgements regarding the patients' level of self-efficacy to enact any previously promoted diabetes and oral care maintenance, in combination with ongoing oral health risk-taking behaviours, such as smoking, may negatively influence the levels of concern they hold for the patients' complaint of a loose tooth. Potentially DHPs may perceive patients' complaints of ill-fitting and loose teeth as an irreversible outcome of poor self-care combined with a disease process that has advanced to a point which requires dental intervention alone. While the impact of health professionals' own health beliefs and attitudes upon their service delivery has been investigated in some other practice areas, evidence within the area of diabetes related oral health assessment and promotion is lacking and may be an area for future research.

The implications of these findings for diabetes management are that it emphasises the need for increased diabetes related oral health education and skills mastery in oral health assessment within each of the identified professional categories. In addition, it demonstrates the need for a standardised diabetes-specific oral health assessment tool. This would enable not only the identification of the incidence and prevalence rates for

oral health complications within the population living with diabetes, but also facilitate appropriate management when oral health complications are identified.

Likelihood in recommending treatment options to patients with oral health complaints. Within this study DHPs were offered a practice scenario in which the patient presented with the oral condition xerostomia. This condition was chosen as it is a common side effect of many oral medications taken by people living with diabetes. It is also associated with a hyperglycaemic state and salivary gland dysfunction, and predisposes the individual to gingivitis and periodontitis. DHPs indicated a moderately low likelihood of recommending the restricted use of caffeine and alcohol which may accentuate dehydration in the person living with diabetes. However, recommendations which may have afforded symptomatic relief, i.e., sugarless gums or mints, saliva substitutes, and fluoride mouthwashes, were less likely to be recommended.

Furthermore, the majority of DHPs indicated they were mid-range on the Likert scale in recommending to patients the options of frequent sips of water and undergoing a medication review as part of the management plan for the xerostomia condition. The data suggest the DHPs are not fully aware of the potential causes of xerostomia, or the benefits that short term management can offer. The treatment options that DHPs indicated they were most likely to recommend to the patient were improving the glycaemic control, referral of the patient to a GP, and referral to a dentist/periodontist for review. These results demonstrate the DHPs' scope of practice is essentially limited to the area of glycaemic management and that referral to the GP and dentist/periodontist for intervention was required in order to manage the oral health complication.

The association of diabetes related oral health education either within the professional course or attendance at an education session with the likelihood to recommend the treatment options offered within this study, was not statistically significant despite the larger sample size within these educational categories. However, recommendations that the patient use sugarless gum, take frequent sips of water or ice chips, and see their General Practitioner (GP) was statistically significant for DHPs who undertook self-directed learning. The data suggests the level of motivation in DHPs to undertake self-directed learning in diabetes related oral health education, as opposed to education received in the professional course or attendance at an oral health education session, is a positive influence upon their likelihood of recommending self-management options and professional care to their patients.

The data indicates the scope of practice by those DHPs who undertook self-directed education is predominately limited to the symptomatic relief of xerostomia Clinically this is of concern, as there is apparent neglect not only for improved glycaemic management, but also a comprehensive approach to oral health management. While it may reflect the absence of a diabetes-specific oral health guideline to direct practice, it also reflects the lack of implementation of research-based knowledge, which clearly demonstrates the combination of strategies improves the individuals' quality of life (Rubin & Peyrot, 1999) and reduces their risk of developing gingivitis and periodontitis in the future (Hirsch, 2004).

Further investigation revealed statistically significant positive relationships existed between the DHPs' levels of confidence to provide diabetes related oral health information and their likelihood of recommending treatment options to the patients with xerostomia. These included: the use of sugarless gum; use of a saliva substitute; restriction in caffeine; restriction in alcohol intake; undergoing a medication review; referral to the GP; and referral to the dentist/periodontist for review of their oral health

condition. While not all the subscale items within the treatment recommendation variable reached the significance level, the data suggest the DHPs, when presented with a patient with xerostomia, would to a large extent implement management strategies that were relevant to the xerostomia condition. The lack of statistically significant data related to the recommendations: use of sugarless mints; to take frequent sips of water or ice chips; use of a fluoride mouthwash, and improving the glycaemic control. The findings suggest the DHPs were not fully confident in providing diabetes related information, in particular relating the risks associated with the patients' hyperglycaemia to that of the xerostomia condition.

While this data suggest DHPs' lack knowledge regarding the association of diabetes with the xerostomia condition, it also indicates a broader lack of knowledge of oral health complications. It is also plausible that DHPs may not readily recommend treatment options which they may consider offer dubious benefit to their patients. This evidence, in the absence of other studies with which to compare results, is worthy of further investigation given knowledge and beliefs is at the core of DHP scope of practice. The data however, provides further evidence from an Australian context which supports the view of Lalla (Albert et al., 2012), that health professionals not only feel uncomfortable performing a simple periodontal examination in the person living with diabetes, but also rarely advise their patients regarding the various aspects of oral health.

Driving and restraining forces in management of diabetes and oral health complications

In accordance with the third objective of this study the restraining and driving forces that influence the Australian DHPs' provision of oral health care prevention and

intervention for people living with diabetes were identified. These forces are explored within the context of current health system policies.

The DHPs in this study identified the positive factors that would influence their ability to improve oral health care in the patients they manage, in greater numbers, over those items that were considered barriers to being able to provide oral health care to patients in their practice. While there is an absence of previous data with which to compare results from this study, it does suggests a readiness by Australian DPHs to implement clinical practice behaviour change. This may be facilitated through the future introduction of diabetes related oral health clinical practice guidelines. In addition diabetes related oral health education provision via the professional organisations and institutional health professional curricula would be advantageous.

Perception of responsibility for professional role in diabetes related oral health care assessment and management. Australian DHPs perceived the provision of assessment and management of diabetes related oral health care to the population of people living with diabetes was largely the role and responsibility of the dental health and DHPs. This was in addition to more than half of the DHPs who identified a role by health professionals employed within the primary care setting, and to a lesser extent allied health professionals and professionals from other health disciplines.

This perception of role responsibility is of clinical importance. In essence it is another force impacting upon the DHPs' levels of concern for patients' oral health signs and symptoms, their likelihood to investigate any oral health complaints further, and their likelihood to recommend treatment when diabetes related oral health complications are identified. In conjunction with the range of driving and restraining forces identified, the perception of role responsibility reflects the limited resources

which are available to DHPs to enable management of patients with oral health complications.

Overcoming the barriers.

Access to oral health services. Within this study, the differences in the response rates for access to dental services, either as driving or restraining force, was seven percent. This suggests the Australian DHPs consider the patients' access to dental services is both a significant driving and restraining force to their implementation of diabetes related oral health management. The data also indicates people with diabetes receive somewhat limited support from the DHPs due to the confines of the current oral health service delivery model. Nonetheless, this may improve with increased awareness and knowledge of oral health complications, greater provision of diabetes related oral health education at the consultation, and with improved referral options to oral health services. Despite these difficulties, DHPs indicated a high likelihood to refer patients with an oral health complaint to a dentist/periodontist (Mean 4.17, SD 1.141, CI 3.96, 4.38). There will, with the potential increase in DHPs activity, be the requirement for dental services to be available, affordable and hence accessible for the patient, in order for referrals to be initiated and actioned.

Dental service access for patients was identified by 64.1% of DHPs as the primary barrier encountered in management of oral health complications. The difficulties appear most pertinent for those patients living in rural and remote communities and are in agreement with that reported within 'Australia's dental generations: National survey of adult oral health 2004-2006' (Slade, Spencer & Roberts-Thomson, 2007) indicating a significant proportion of the population with diabetes, indeed have an unmet need for oral health care. The issues in accessing oral health services due to supply of dental

professionals is not significantly different to that of medical practitioner services in inner regional, outer regional and remote areas (AIHW, 2010a).

The provision of medical and oral services to people with diabetes in Australia is complex. Current separation of Commonwealth funding for medical and dental services limits access to oral health care. Additional differences among the States'/Territories' impacts further on oral health service delivery. In 2010-2011 the Commonwealth funded medical expenditure to the value of 17,600 million dollars. In contrast dental services in the same period received both Commonwealth and State/Territory funding to the value 2,136 million dollars (AIHW, 2012a, p. 115). While this represents 27.2% funding by Commonwealth and States/Territories Governments for dental service expenditure, the bulk of funding (58.1%), was supplied by individuals with 'out-of-pocket' payments (AIHW, 2012a, p 76). The remaining funds (14.7%) were largely sourced from private health insurance companies, with a minor proportion provided by Workers' Compensation and compulsory third-party motor vehicle insurers (AIHW, 2012a, p 119). Furthermore, the reported real growth in dental services expenditure averaged 4.0% per year. This is identified as 1.5 percentage points below the average annual real growth in total recurrent health expenditure of 5.5% for the period 2003–04 to 2010–11 (AIHW, 2012a). The Commonwealth Government does not collect data identifying the current level of oral health service delivery to people living with diabetes, nor the level of need for oral health care that is unmet in this cohort. Therefore, this data indicates that not only do current provisions not meet the needs of the wider Australian population, but also the needs of individuals with oral health complications managed by Australian DHPs.

Despite increased funding for public oral health services, available data identified dental care waiting times across Australia (June 2002) was 18 to 39 months, leading to an increased proportion of people being managed as emergency dental cases (National

Advisory Committee on Oral Health, 2004). While newer data is not available, the funding over the decade has not increased significantly suggesting waiting times for services would remain relatively stable to the present time. Therefore, this provides a possible explanation for difficulties DHPs reported in this study, in being able to have their patients seen in a timely manner. Evidence shows the long waiting lists in the public dental sector "result in late presentation of dental problems necessitating extraction, which may be the treatment of choice of either the patient or the dentist" (Roberts-Thomson & Loc Do, 2007). This supports additional data that indicates most dental service funds were "allocated to the reparation of tissue injury caused by dental caries and periodontal disease" (National Advisory Committee on Oral Health, 2004, p. 8).

Funding of oral health service provision. Within this current study, access to Medicare funded oral health services were identified as a driving force by 66% of DHPs. Access to the Medicare Chronic Disease Dental scheme allowed people living with diabetes who had a Medicare GP Management Plan in place, access to a private dentist for care (DOHA 2010c, 2010d). With the closure of this scheme as of the 1st December, 2012, these individuals will now face an extended wait upon the public service listings.

Evidence of dental service utilisation rates reported within the 'Australia's dental generations: National survey of adult oral health 2004-2006' showed "59.4% of the Australian population aged 15 years or more had visited a dentist within the last 12 months" (Spencer & Harford, 2007, p. 143). The greater numbers of dental visits in the preceding 12 months were associated with the respondent living within a capital city, having a higher level of education, with a higher percentage of those also being ineligible for public dental services. However, 11.8% of all Australians 15 years old

and over had not attended a dentist within the last 5 years. These individuals were therefore, considered to be 'outside' of the dental care system (Spencer & Harford, 2007). This data was reported as being "strongly associated with usually visiting for a dental problem and edentulism; and moderately associated with being uninsured, eligible for public dental care, having less schooling, living in places other than capital cities and being Indigenous" (Spencer & Harford, 2007, p. 148).

Many individuals in Australia receive income above the minimum Henderson Poverty Line income level of $26, 000, and therefore are deemed ineligible for public dental services. To access alternative oral health services is dependent upon the patient's capacity to pay to attend a private dentist, which according to the Australian Dental Association (2003), "costs an average of $295 per hour (ranging from $200 to $450)" (As cited in National Advisory Committee on Oral Health, 2004, p. 11). The responses received from DHPs within this current study identified the cost of services is prohibitive to many individuals and their dependants accessing dental care, especially when there is an ongoing financial demand associated with managing a chronic disease such as diabetes. The evidence within the AIHW (2012b) report entitled 'Chronic disease and oral health', identified people living with diabetes were less likely, than people with any other chronic condition, to make a dental visit for a check-up, and less likely to visit a private dental practice (Spencer & Ellershaw, 2011, as cited in AIHW 2012b). This issue is consistent with findings from 'Australia's dental generations: The national survey of adult oral health 2004–06', which found 30.0% of the Australian population aged 15 years or more, who were surveyed reported they either delayed or avoided dental care due to the cost (Spencer & Harford, 2007).

Despite this evidence, a differing view is reported by the National Advisory Committee on Oral Health (2004) that contradicts, in part, the financial burden for

people with diabetes to seek regular oral health care, stating "while there is a predominance of privately funded dental services, it reinforces a perception by some that oral health services are essentially elective in nature, and hence of low priority" (p 11). Regardless of the financial barriers, the identified gap in service provision to a ever increasing diabetes population neglects to acknowledge the need for improved management of not only diabetes related oral health complications, but also the ongoing need for preventative oral care, which places the individuals at significant future risk.

Referral of patients with oral health complications to the GP. Within this study DHPs identified the availability of multidisciplinary team care arrangements and streamlined referral processes as a driving force. Additionally they identified a greater likelihood to recommend referral of the patient to the GP when signs and symptoms of oral health conditions were evident (Mean 4.22, SD 0.924, CI 4.04, 4.40). While this may relate to DHPs having greater access to a GP than a dentist, especially within rural and remote communities, it may also relate to DHPs' assessment findings; regarding the type and severity of the patients' oral condition, which influences the referral.

However, the relationships between the DHPs' likelihood to refer to the GP/dentist when a specific type of oral condition was identified, and their levels of concern for those conditions, were not investigated within this current study. This may be an area worthy of research in future studies.

The DHPs' referral of the patient with diabetes related oral health complications to the patients' GP for management is not without problems. Evidence within reports entitled, i.e., 'National oral health plan 2004-2013', 'General practice activity in Australia 2010–11', 'A decade of Australian general practice activity, 2001-02 to 2010- 11' and 'Australia's health 2010', show the issues faced by both health

professionals and individuals who seek management of oral health complications. These issues in management will be elaborated further.

Evidence of GP management of oral health complications to date within 'National oral health plan 2004-2013' suggest the number of visits to a GP for dental problems in the period 1998 to 2000 were estimated to be in the order of over 500,000 (Britt et al., 1999, as cited in NACOH, 2004). However, the allocation of over $10 million of Medicare resources to these services was later deemed by the Australian Health Ministers' Advisory Council to be an inappropriate use of medical services for oral health problems that were best managed by an oral health practitioner (NACOH, 2004)

Additionally teeth and gum disease was identified in the 'General practice activity in Australia 2010-2011' as the problem most likely to result in a GP referral to an allied health professional (which includes dentist), with 3.4% of all patient contacts resulting in a referral to a dentist. This accounted for 2.9% of all referrals generated within general practice (Britt et al., 2011a). The review of GP management over the past decade indicated referrals both in the number of patients presenting requiring dental treatment for problems with their teeth/gum disease, and in GP referral rates to dentists for the number of patients encountered had doubled since 2008. The data however, does not identify incidence and prevalence rates of diabetes related oral health complications in patients within the general practice setting. Neither is it known whether GP management of patients, who are referred by DHPs for oral health complications, occurs in an appropriate, affordable and timely manner which meets patients' satisfaction.

However, an indicator of the extent of GP management of care for people living with diabetes is potentially the RACGP 'diabetes annual cycle of care'. The AIHW (2010a) reported the percentage of people with diabetes who received entitlement to the Medicare Benefits Scheduled rebate for the diabetes annual cycle of care service in

2008-2009 was 19.1%, with only 8% of people living in remote areas receiving this service. While the annual cycle of care is considered best-practice management of people with diabetes, it does not encompass oral health complication screening as part of the care provision.

From the evidence to date, it appears that despite the AIHW data identifying the ever increasing incidence of diabetes in the Australian population, in addition to the increased number of patients presenting to GPs with oral health complications (Britt et al., 2011b), the current system for planned management of patients with diabetes may not identify oral health complications. This suggests that patients receive a low level of oral health service as part of primary health. Therefore, increased referrals of patients with severe oral health complications, as a result of increased screening by DHPs, would not be appropriately managed within this setting.

As can be seen, access to timely, affordable and appropriate oral health services, is difficult for the majority of Australians. A greater level of difficulty exists for those who live in rural and remote areas, or have more specific needs. Given the fragmentation in oral health service access and provision, it is comprehensible that preventable oral health care is neglected. For DHPs managing the care of people living with diabetes, this study suggests it is not until oral symptoms of advanced periodontal disease affects the patient's diabetes management, general health and quality of life, that the individual will seek input from a health professional.

According to Spencer, Slade, Sendzuik & Harford (2007), patients' "perceptions of dental treatment needs are a complex interplay of people's current burden of oral disease, their expectations, and the availability and obtainability of dental care" p. 245. Unfortunately the outcome of this increases the demand upon the finite personnel and fiscal resources of Australia's health system further.

Strengths and Limitations of the study

This is the first Australian study to assess DHPs' knowledge of diabetes related oral health complications, and their scope of practice in managing these conditions in people living with diabetes. The level of evidence achieved within the Australian context will not only provide a baseline for which to compare future research, but also assist in the development of educational materials, clinical practice guidelines and further research studies.

There were several limitations to this study. These related to the study methodology, sampling method and instrument. As a result caution is needed in the interpretation of the findings and generalising them to other populations of DHPs outside of this study. Potential sources of bias were recognized as threats to the internal and external validity of this study and its results, which are discussed further.

Study design. This study utilised a cross-sectional design. This design investigates a subject of interest and the health variables in the study subjects at a single point in time (Levin, 2006); therefore, it is not possible to make judgements regarding their cause and effect. The discussion of the data considered the relationships between the variables to meet the study objectives; therefore, the cross sectional design was deemed appropriate methodology to achieve this.

Sampling issues. Members of the ADS and ADEA were recruited as they were considered the most appropriate peak body organisations representing DHPs who have greater specific knowledge and input into the management of people living with diabetes. It was not anticipated that changes in both the ADS and ADEA executive board membership would cause delays, resulting in a secondary approval process of the study proposal and documents. The impact of these changes was the need for a

renewal of the Curtin University Human Research Ethics Committee approval. Access to the DHPs was further impeded by the distribution of the study invitation within the ADS and ADEA electronic newsletters coinciding with the period where many members were absence from their normal duties attending annual international and national scientific conferences, or school term holidays.

Response rate. The expected sample size quoted in Chapter 3 was not achieved due to the inability to fully access the ADS and ADEA membership. This is recognised as a significant source of response bias, given the number representing the two member associations were significantly different, with membership of the ADS significantly under-represented. The data results achieved from the DHPs may also be substantially different from those members who did not participate in the study, and as such the results may neither be truly representative nor able to be generalised to the wider population of Australian DHPs (Barratt & Kirwan, 2009). With hindsight, the electronic newsletter invitation format singularly, is not considered the most appropriate form of distribution. Potentially clinicians will not read newsletters during their busy clinical practice activities, and when administration time is available, will often skip over items they consider of lesser importance to them on the day. An individualised invitation distributed by personal email or letter may have achieved a greater response to the study invitation. While this was not an option available in this study, future researchers may benefit from the ADS and ADEA supporting a direct approach to their memberships. It has since been identified that the targeting of a paper invitation to members at a trade stand at the ADS/ADEA annual scientific conference would more than likely have achieved a greater awareness of the study and hence a greater response rate to the study invitation.

An extensive literature search was performed to seek an established instrument; however, as previous studies have not investigated diabetes health professionals' knowledge of oral health complications or their management within a diabetes population, there was an absence of a tool to use within this study. As a result it was necessary to develop a survey tool based upon the literature review, mapping of clinical evidence-based guidelines from dental and diabetes associations within the US, Canada and Europe, and the research objectives guiding the study. Response rates to individual questions across the survey tool did vary. Layout of the questionnaire during the pilot phase considered the specific grouping of questions to meet the needs for requirements for data collection against the three study objectives. Consideration of the likely practices of the participants informed the layout of the questionnaire during the pilot phase of the study. Attempts to keep participants' interest was considered important, and enabled by allowing omission (by skipping) of questions by participants that were not applicable to their clinical practice. Earlier completion of the questionnaire by those participants who did not directly see patients in their practice was considered appropriate.

However, the impact of a participant closing the web-based SurveyMonkey questionnaire page prior to the completion of the questionnaire was not anticipated. The researcher had not foreseen the potential for participants to either be interrupted mid-completion and close the web-page, or inadvertently close the webpage instead of clicking the 'next page' tab on the electronic questionnaire. As a result, information regarding 'how to re-access' their partially completed questionnaire had not been included at the start of the questionnaire. During analysis, it was noted that the loss of six participants from the survey at Question 11 and a further three at Question 17 corresponded with the end of the questionnaire pages. A further 22 participants, 19 of whom identified it was not within their scope of practice to perform diabetes and oral

assessments, correctly exited the questionnaire at that point. Therefore a total of 12 participants did not complete the questionnaire in its entirety as expected. It is recognised therefore, that these occurrences has introduced another source of response bias into the data results.

Self-report and recall bias. In addition, participants' responses may be influenced by what they believe is socially acceptable answers rather than the truth (Barratt & Kirwan, 2009). Participants, although responding anonymously, had a personal desire to provide answers that the researcher may see as favourable, or alter their responses as a result of not wanting to be seen as being unaware of the issues on diabetes and oral health complications. Participants' recall of details, such as provision of education on diabetes and oral health complications as part of their course, or the length of time when last undertaking educational activities, may be altered over time thus introducing further bias into the data results.

Study instrument validity and reliability. The data results achieved within a study are considered to have greater meaning when the study instrument is reliable and valid (Bland, 2005). A reliability analysis was undertaken upon the tool generated for use within this current study. To assess the internal consistency of six subscales, the Cronbach's alpha statistic was examined. Participants' demographic information, with the exception of two items which identified the patient population consulted, were omitted from the analysis as the inclusion of these items was deemed by the researcher not to be appropriate given their categorical nature. The reliability coefficients for the subscales within the questionnaire ranged from .38 to .87. Two subscales; the 'patient population managed', and 'diabetes and oral health complications education', showed a Cronbach's alpha <.70, which suggested they were not reliable measures within the

study. The correlations between each item and the remaining items' scale scores in was examined in order to test the items internal consistency The descriptive statistics for the reliability analysis of the items are described in Appendix W.

The removal of lower scoring items (less than <.40) from these subscales, in order to increase the internal consistency, did not result in an improvement in the Cronbach's alpha scores to the acceptable minimum level of >.70. In accordance with that reported by Peat (2001), the removal of items was not considered favourable as this approach severely limits the ability to capture clinically important data across a broad range of domains, with the results being of limited value within this cross sectional, descriptive study. Peat reports "It is better to sacrifice internal consistency for content validity, that is, to maintain a broad scope by including questions that are both comprehensive in the information they obtain and are easily understood."(p. 109). As such, attempts to improve the validity of this study have taken a balanced approach which considered the clinical experience of pilot phase team members and their interpretation of each item, the aims of the study, the length of the questionnaire for participants, the interpretation of the data test results, and the repeatability statistics achieved. Further psychometric tests were not undertaken on the scale questions, with this recognised as a weakness of this study. However, an assessment of the data indicated further tests would be of limited value in confirming reliability.

Statistical analysis. Data screening indicated small sample size across the health professional categories resulted in the skewing of data results across the variables: 'the undertaking of education in diabetes and oral health complications', 'the levels of confidence to assess oral health signs and symptoms', and 'provide diabetes and oral health information to patients' in particular. The normality of the data could not be assured despite regrouping of appropriate variables and the logarithmic

transformations. Therefore, the tests of significance were limited to the non-parametric methods such as the Chi-Square with Fishers Exact Tests, Mann-Whitney Tests and Pearson's Rank Correlation Tests. While these were applied appropriately and consistently to maintain the validity of the study data, it is recognised the use of these distribution-free tests may have resulted in a loss of power to detect clinically important differences. Thus, a type II error in the reporting of non-significant data results may have erroneously occurred (Peat, 2001).

Recommendations

There are a number of recommendations that arise from this study. Before the findings of this study can be considered valid, the validity and reliability of the study instrument must be tested using a larger sample of Australian DHPs. A future Australian study may consider including countries such as New Zealand, Canada and America, with appropriate adjustment to the study tool to reflect the ethnic differences that exist in patients residing in those countries. New Zealand, Canadian and American health systems provide for DHP practices and management of diabetes that is similar to that undertaken by Australian DHPs. The knowledge to be gained from future studies could have a positive impact upon practices and policies addressing the needs of people living with diabetes.

This current study identified a need for more education and training in oral health complications and assessment skill mastery. To address the limitation in DHPs' knowledge and confidence to undertake oral health practices, it is recommended that an education programme be developed and delivered by the ADS and ADEA. To achieve maximum exposure to members, these activities should be provided at both National and State conferences.

The DHPs in this study indicated their scope of practice in diabetes related oral health complications was limited by not only their lack of knowledge and levels of confidence to undertake practice in their clinical setting, but also by a lack of guidance. This could be remedied with the provision of a clinical guideline and diabetes specific oral health assessment tool to focus the DHPs' attention towards assessment of their patients' oral cavity. This is especially so when specific signs and symptoms, or risk factors for oral complications are identified. As diabetes is a significant factor in the pathogenesis of periodontal disease, it would appear that a group of DHPs committed to quality improvement from within the ADS and ADEA would be best placed to develop these clinical tools further.

Finally, the biggest barrier to DHPs' provision of improved care in the area of diabetes related oral health complications identified from this study was the limited access to oral health services. The availability and access to affordable dental care, particularly for those whose income is marginally above the minimum level to receive public dental services was a major factor identified from DHPs' statements. In the absence of public oral health services, private dental fee-for-service was prohibitive for many seeking care, with rebates only available if they afforded private health insurance. As a result, a significant proportion of people living with diabetes were reported as not seeking regular long-term management of their oral health. The outcome of which is a state of poor dentition with progression to periodontal disease, and poorer outcomes associated with their diabetes management. Given the ever increasing rate of diabetes within Australia, it is a recommendation that the Commonwealth Government reconsider the specific oral health needs of people living with diabetes and make provision for the funding of a diabetes-specific oral health service. In order to meet the service gap identified from this study authorised DHPs, as currently occurs under the Australian National Diabetes Supplies Scheme, would be

entitled to directly refer patients to this service, who they have assessed and identified as being individuals at high risk for oral health complications.

Conclusion

This study has assessed the Australian DHPs' level of knowledge of oral health issues which impact upon the person with diabetes. It has described the scope of practice regarding intervention, health promotion and care management of the oral health issues. It has identified the restraining and driving forces that influence DHPs' provision of oral health care interventions for people with diabetes in Australia. The findings of this study were discussed in the context of the current health system policies and their impact upon DHP management of diabetes related oral health complications.

Although the results of this study are not able to be generalised beyond the sample of Australian DHPs surveyed, the finding have shown DHPs do possess knowledge of the more common oral health complications that may develop in people with diabetes, and may potentially identify these in a patient presenting at a consultation, however they are unable to recognise the association of the more obscure signs and symptoms of oral complications. As such they may not correctly identify the conditions in the patient under their care.

DHPs' knowledgebase of oral health is limited. The receipt of education in diabetes related oral health complications amongst the DHPs varied significantly. It appears that Australian DHPs do not receive adequate education and training to manage oral health complications within diabetes care. This is most likely related to the limited promotion of diabetes related oral health complications within the Australian medical, nursing and allied health professional curricula and diabetes-specific medical literature. DHPs have traditionally received little in the way of training in oral health. They lack the skill mastery to confidently assess their patients'

oral cavity, and provide diabetes related oral health information, the absence of the clinical practice guideline and diabetes-specific oral health screening tool contributes to this deficit. As a result many DHPs identified oral health complication management was outside of their scope of practice.

Overwhelmingly DHPs acknowledged the significance of an increased risk of oral health problems in the person living with diabetes. This positively illustrates that DHPs are aware of the potential for oral health complications within the clinical practice setting. The management of patients who DHPs considered to be at risk because they were within a specific needs category were not managed differently from the general population of patients with diabetes who they consulted. However, there was a strong association between the DHPs' acknowledgement of increased risk of oral complications with the increased levels of likelihood to investigate the patients' complaints of signs and symptoms. Furthermore, higher scores in levels of confidence to assess the oral health status and provide diabetes related oral health information to patients were detected when other diabetes complications were identified in the individual.

This is an encouraging sign. The DHPs were cognisant of the need to monitor outcomes for people that were at greater risk. The DHPs' levels of confidence to assess oral signs and symptoms, to provide diabetes related oral health information, and to recommend treatment options to their patients' could be increased through provision of education. Opportunities to enhance assessment skills would be most effective if offered within the forums provided by the ADS and ADEA. In addition, the promotion of oral health complications from within the member organisations with their support for the development of both a clinical practice guideline and diabetes specific assessment tool would enable DHPs to practice with greater levels of

confidence and thus increase the levels of concern and likelihood to recommend treatment options to patients who are affected by oral health complications.

This study has shown there is a potential to change the practice behaviours of DHPs, especially in those who have previously believed oral health complication management is outside of their scope of practice. However, the driving and restraining forces for DHP management of patients experiencing oral health complications are predominately those related to the current health system policies which determine the delivery of oral health services across the metropolitan, regional and remote areas of Australia. While education and skill mastery can go some way towards improving outcomes in care, it is ultimately the provision of oral health services which needs the greatest change. With increased education of DHPs in the area of diabetes related oral health complications, it is hoped that a united voice will sound from members of the ADS and ADEA to advocate for Commonwealth Government recognition of the impact of oral health complications on the lives of people with diabetes. Only then will change in policy and funding for programs which will meet this area of specific need be forthcoming to enable Australia's DHPs to practice to their full potential.

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List of Appendices

APPENDIX

DIABETES AND ORAL HEALTH COMPLICATIONS: KNOWLEDGE AND SCOPE OF PRACTICE QUESTIONNAIRE

1. Which of the following organisations are you currently a member of?

- ☐ Australian Diabetes Society
- ☐ Australian Diabetes Educators Association

2. Are you a credentialed member of the ADS or ADEA organisations?

- ☐ Yes
- ☐ No

3. What is your principle profession? (Please select ONE only)

- ☐ Endocrinologist
- ☐ Registered Medical Practitioner
- ☐ Scientist
- ☐ Diabetes Nurse Educator
- ☐ Nurse Practitioner
- ☐ Dietitian
- ☐ Pharmacist
- ☐ Podiatrist
- ☐ Other (please specify) _____

4. Do you work solely in diabetes care?

- ☐ No, I work in a generalised health care area → go to Question 6
- ☐ Yes
- ☐ Other (please specify) _____

5. How many years of experience do you have *specifically* in diabetes care? (Please round to the nearest category)

- ☐ Less than 1 year
- ☐ 1 to 5 years
- ☐ 6 to 10 years
- ☐ 11 to 15 years
- ☐ 16 to 20 years
- ☐ 21 to 25 years
- ☐ More than 25 years

6. What is your primary employment setting? (Please select ONE only)

- ☐ Private practice
- ☐ GP practice
- ☐ Public hospital
- ☐ Private hospital
- ☐ Community health centre
- ☐ Other (please specify) _____

7. What is the postcode of this position? _____

8. Do you work directly with patients/clients in your role?

- ☐ No → go to question 11 on the next page
- ☐ Yes

9. What is the age group of the patients/clients with whom you work? (Please number in sequence, 1, 2, 3, where 1 indicates the patients/clients you see most. Please record a 0 if you do not see the age group)

- ☐ Paediatrics
- ☐ Adolescents
- ☐ Adults

10. Do you work with patients/clients who are from the following groups? (Please select all that apply)

- ☐ Pregnant women
- ☐ Physically and intellectually disabled
- ☐ Aboriginal and Torres Strait Islander
- ☐ Other clients from CALD (culturally and linguistically diverse) backgrounds
- ☐ Residential aged care clients
- ☐ Clients within secure facilities
- ☐ Rural and/or Remote communities
- ☐ No, I do not see any of the above patient/client groups
- ☐ Other (please specify type of patient/client) _____

11. Was oral health complications in diabetes covered during your professional education?

- ☐ Yes
- ☐ No
- ☐ Cannot recall

12. Have you ever attended an education session on diabetes and oral health complications?

- ☐ No → go to Question 14
- ☐ Yes, attended this in last 5 years
- ☐ Yes, attended this more than 5 years ago

13. In what form was this education delivered? (Please select ONE only)

- ☐ University lecture
- ☐ A professional association conference session /seminar
- ☐ Industry sponsored seminar
- ☐ In-service session delivered by a member of the health care team
- ☐ Other (please specify) _____

14. Have you undertaken any self-directed learning in the area of diabetes and oral health complications?

- ☐ No → go to Question 16
- ☐ Yes

15. Which of the following forms did you use to acquire extra knowledge? (Please select ONE only)

- ☐ CD-rom self-instructional tools
- ☐ Web-based instructional modules
- ☐ Core textbooks
- ☐ Journals
- ☐ All/Most of the above
- ☐ Other (please identify the education form) _____

16. Research indicates that diabetes is known to be associated with certain oral manifestations.

From *your* clinical experience and knowledge of diabetes, is there an *association* between diabetes and the following oral health problems?

	Yes	No	Don't know
Glossodynia and or stomatopyrosis (Burning mouth syndrome)	□	□	□
Candidiasis	□	□	□
Dental caries	□	□	□
Gingivitis	□	□	□
Mouth ulcers	□	□	□
Lichen planus (Lichenoid autoimmune mucositis)	□	□	□
Oral neurosensory dysesthesia (Well localised, irritating sensations)	□	□	□
Oral cancerous lesions	□	□	□
Periodontitis	□	□	□
Excessive salivation	□	□	□
Taste impairment	□	□	□
Xerostomia (Dry mouth)	□	□	□
Dysphagia (Difficulty swallowing)	□	□	□

17. "The significance of an increased risk of oral health problems in people with diabetes is *only relevant if* the patient/client has been diagnosed with another diabetes related complication".

When considering this above statement, I..

Strongly disagree □1 □2 □3 □4 □5 Strongly agree

18. On a scale of 1 to 5 (1 being not confident and 5 being very confident), please indicate how confident you feel in:

a. Assessing oral health signs and symptoms in the people with diabetes you see?

Not confident □1 □2 □3 □4 □5 Very confident

b. Providing diabetes related oral health information to the patients/clients you see?

Not confident □ 1 □2 □3 □4 □5 Very confident

19. If a patient/client with diabetes presents with signs of diabetes related complications e.g. retinopathy, nephropathy, neuropathy; how likely are you to investigate for signs and symptoms of dental problems at this consultation?

Please indicate:

Highly unlikely □ 1 □2 □3 □4 □5 Highly likely

20. In considering provision of care to people with diabetes, which health professionals do you consider has a role in the assessment and management of diabetes related oral health care?

21. What factors will influence your ability to *improve* the diabetes related oral health care for people that you manage? (Please select all that apply)

- □ None, I consider it outside my professional scope of practice
- □ Further 'diabetes and oral health care' professional development
- □ On line chat group
- □ Diabetes and oral health clinical practice guidelines
- □ 'Diabetes and oral health care" education pamphlets for patients/clients
- □ 'Oral Health Care Services' information pamphlets for patients/clients
- □ Greater access to dental services
- □ Streamlined referral processes
- □ Medicare item provision
- □ Multidisciplinary team care arrangements
- □ Other (please specify)

22. What do you consider are barriers to you being able to provide diabetes related oral health care in your practice? (Please select all that apply)

- □ Not in my professional scope of practice
- □ Lack of knowledge of diabetes and oral health issues
- □ Lack of clinical practice guidelines
- □ Lack of referral processes
- □ Lack of access to dental services
- □ Lack of reimbursement for management time required
- □ Lack of time to include oral health issues in my management of diabetes
- □ Lack of recognition of my role in diabetes and oral health education

□ Other (please specify) _____

23. When assessing/screening for complications in the person with diabetes, how often would this *include* oral health signs and symptoms?

□ Never, it is not within my scope of practice to perform diabetes and oral health assessments → if you have selected this response you have completed the survey.

□ Each visit

□ Quarterly

□ Half yearly

□ Yearly

□ I do not routinely perform diabetes and oral health assessments

□ Other (please specify) _____

24. Please indicate which of the following actions are included in your assessment of the patient/client with diabetes. (Please select all that apply)

□ Routine oral health screening questions

□ Specific diabetes and oral health risk assessments

□ Discuss risk-related behaviours and outcomes upon oral health e.g. poor oral hygiene, smoking and glycaemic control

□ Discuss preventative oral health care behaviour e.g. brushing, flossing and mouthwash use

□ I recommend to the patient that they attend a dentist/periodontist appointment for assessment and care follow -up

□ I refer to a dentist/periodontist if I perceive the need

25. In which presenting circumstances, would you investigate the oral health status of this patient/client? (Please select all that apply)

□ When the patient/client is hyperglycaemic *with* known cause

□ When the patient/client is hyperglycaemic *without* identified cause

□ When the patient/client is pregnant *or* planning pregnancy

□ Only when a specific oral health concern or complaint is identified by the patient/client

□ When referred by a dentist/periodontist

□ Other (please specify) _____

26. A person with diabetes presents with a complaint of a "sore mouth" and a history of mouth ulcers. Please indicate which of the following actions you are likely to undertake at this consultation?

		Yes	No
a.	Inspection of the hard and soft tissues in the mouth cavity	☐	☐
b.	Inspection of the teeth	☐	☐
c.	Note number of teeth present or missing	☐	☐
d.	Note presence of oral infections	☐	☐
e.	Note presence of oral lesions	☐	☐
f.	Document oral findings and diagnosis	☐	☐
g.	Question the patient regarding:		
I.	Glycaemic control	☐	☐
II.	Frequency of personal dental care activity	☐	☐
III.	Frequency of professional dental care visits	☐	☐
IV.	Recent changes in taste sensation	☐	☐
V.	Recent changes to food choices in respect to flavours	☐	☐
VI.	Oral medications intake	☐	☐
VII.	Level of hydration	☐	☐
VIII.	Referral to dentist/periodontist	☐	☐
h.	Other actions undertaken (please specify)		

27. The patient /client who complained of a sore mouth and a history of mouth ulcers now reports further symptoms. You conduct an assessment of the oral cavity and find the following problems.

Please indicate on a scale of 1 to 5 (1 being no concern and 5 being very concerned), the level of concern you would have.

a. Bleeding gums when brushing:

No concern ☐1 ☐2 ☐3 ☐4 ☐5 Very concerned

b. Loose teeth:

No concern ☐1 ☐2 ☐3 ☐4 ☐5 Very concerned

c. Changes in the way the teeth fit together:

No concern ☐1 ☐2 ☐3 ☐4 ☐5 Very concerned

d. Pain when chewing:

No concern ☐1 ☐2 ☐3 ☐4 ☐5 Very concerned

e. Red, swollen or tender gums:

No concern ☐1 ☐2 ☐3 ☐4 ☐5 Very concerned

f. Noted halitosis or is informed by others of breath odour:

No concern ☐1 ☐2 ☐3 ☐4 ☐5 Very concerned

g. Tartar formation:

No concern ☐1 ☐2 ☐3 ☐4 ☐5 Very concerned

28. A patient/client presents complaining of a symptom of a "dry mouth". Please indicate on a scale of 1 to 5 (1 being highly unlikely and 5 being highly likely), how likely you are to suggest the following recommendations in treatment options to this person? (Please select all that apply)

	Highly Unlike1y 1	**2**	**3**	**4**	**Highly Likely 5**
a. To use sugarless gum	☐1	☐2	☐3	☐4	☐5
b. To use sugarless mints	☐1	☐2	☐3	☐4	☐5
c. To take frequent sips of water or ice chips	☐1	☐2	☐3	☐4	☐5
d. To restrict caffeine intake	☐1	☐2	☐3	☐4	☐5
e. To restrict alcohol intake	☐1	☐2	☐3	☐4	☐5
f. To rinse with fluoride mouthwashes	☐1	☐2	☐3	☐4	☐5
g. To use saliva substitutes	☐1	☐2	☐3	☐4	☐5
h. To improve glycaemic control	☐1	☐2	☐3	☐4	☐5
i. To undergo a medication review	☐1	☐2	☐3	☐4	☐5
j. Referral to the GP for review	☐1	☐2	☐3	☐4	☐5
k. Referral to dentist/periodontist for review	☐1	☐2	☐3	☐4	☐5

Thank you for your time in completing this survey.

Catherine McLaine, RN, CDE.

Appendix B: Sample Information sheet for pilot phase panel members in reviewing Study Questionnaire.

Ms Helen McCausland,
Podiatry Department,
7th floor, A block
Royal Hobart Hospital.

Catherine McLaine,
10 Umfrevilles Road,
Kaoota, 7150,
13/08/2009

Dear Helen,

I am enrolled within the Master of Science (Research) course at Curtin University of Technology in Western Australia. I am currently undertaking a study into diabetes and oral health complications, looking specifically at the Australian diabetes health care providers' knowledge and scope of practice in this area or need.

An extensive literature search has failed to identify any established instruments suitable for inclusion within this study. I have therefore, developed a quantitative questionnaire based upon the an extensive literature review, mapping of clinical evidence-based guidelines from Dental and Diabetes Associations within the United Stated of America, Canada and Europe and the research objectives guiding the study.

The instrument is comprised of three parts: 1. Socio-demographic data: six questions survey, professional membership, employment setting and diabetes population managed; 2. Diabetes and oral health education: four knowledge questions including the form of education received and 3. Practice and Efficacy: eleven questions relate to diabetes and oral complication management practices undertaken and the level of confidence in decision making. The form of questioning is a mixture of open, closed and Likert scale items.

I am requesting your assistance in reviewing the enclosed questionnaire to enable modifications to be made to ensure the validity and reliability of this instrument prior to circulation to the Australian Diabetes Society (ADS) and Australian Diabetes Educators Association (ADEA) members.

Review of this instrument will require:

1. Completion of the questionnaire twice. I will provide you the instrument upon two separate occasions to measure the test-retest reliability.
2. I will also require you to complete a separate scale against each of the questions contained within the questionnaire. This measurement of the content validity of the instrument can be completed after the first administration of the questionnaire.

I understand that as you are not a current member of the proposed sample of ADS or ADEA organisation membership, that you will not be included within the final study. Your expert opinion as a care provider to people living with diabetes is highly valuable to my study and I am grateful for your time and effort in participating in this pilot phase of the study.

Yours sincerely

Catherine McLaine,
Clinical Nurse/Credentialed Diabetes Educator,
RHH Diabetes Centre, 7th Floor A Block

Appendix C: Sample Content Validity Index (Waltz and Bausell, 1983) for pilot phase panel member completion following first administration of Study questionnaire

Content Validity Index (Waltz, C.F and Bausell, R.B., 1983)

Question Number	**Relevance** 1= Not relevant 2=Item needs some revision 3=Relevant but needs minor revision 4= Very relevant	**Clarity** 1= Not clear 2=Item needs some revision 3=Clear but needs minor revision 4= Very clear	**Simplicity** 1= Not simple 2=Item needs some revision 3=simple but needs minor revision 4= Very simple	**Ambiguity** 1= Doubtful 2=Item needs some revision 3=No doubt but needs minor revision 4= Meaning is clear	**Suggested changes**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					

Appendix D: Sample Study questionnaire (pilot phase version).

DIABETES AND ORAL HEALTH COMPLICATIONS: KNOWLEDGE AND SCOPE OF PRACTICE QUESTIONNAIRE

1. **Which of the following organisations are you currently a member?**
   - ☐ Australian Diabetes Society
   - ☐ Australian Diabetes Educators Association

2. **To which professional category do you belong?**
   - ☐ Endocrinologist
   - ☐ Registered Medical Practitioner
   - ☐ Scientist
   - ☐ Diabetes Nurse Educator
   - ☐ Nurse Practitioner
   - ☐ Accredited Practicing Dietitian
   - ☐ Registered Pharmacist
   - ☐ Podiatrist
   - ☐ Other_____

3. **How many years of experience do you have *specifically* in diabetes care management?**
   - ☐ Less than 1 year
   - ☐ 1 to 5 years
   - ☐ 5 to 10 years
   - ☐ 10 to 15 years
   - ☐ 15 to 20 years
   - ☐ 20 to 25 years
   - ☐ More than 25 years

4. **What is your current employment setting?** (Please select all that apply)
   - ☐ Private practice
   - ☐ GP practice
   - ☐ Public hospital
   - ☐ Private hospital
   - ☐ Community health centre
   - ☐ Other_____

5. With which client population do you work? (Please select all that apply)

- □ Paediatrics
- □ Adolescents
- □ Adults
- □ Pregnant women
- □ Physically and intellectually disabled
- □ Aboriginal and Torres Strait Islander
- □ Clients from CALD (culturally and linguistically diverse) backgrounds
- □ Residential aged care clients
- □ Clients within secure facilities
- □ Rural and/or Remote communities
- □ Other_____

6. What is the postcode of your main position in diabetes care? □□□□

7. Have you ever attended an education session on diabetes and oral health complications?

- □ Yes_1 → go to Q 8
- □ No_2 → go to Q 9

8. In what form has this education been delivered? (Please select all that apply)

- □ A professional body conference session
- □ University lecture
- □ Industry sponsored seminar
- □ Peer delivered in-service session
- □ Independent learning
- □ CD-rom self-instructional tools
- □ Web-based instructional modules
- □ Core textbooks
- □ Journals
- □ Other_____

9. Was diabetes and oral health complications content covered during your endocrinology studies or diabetes education course?

- □ Yes_1
- □ No_2

10. Research indicates that diabetes is known to be associated with certain oral manifestations.

From *your* clinical experience and knowledge of diabetes, is there an association between diabetes and the following oral health problems?

	Yes$_1$	**No$_2$**
Burning mouth syndrome	□	□
Candidiasis	□	□
Dental caries	□	□
Gingivitis	□	□
Glossodynia and or stomatopyrosis	□	□
Mouth ulcers	□	□
Lichen planus	□	□
Neurosensory dysesthesia	□	□
Oral cancerous lesions	□	□
Periodontitis	□	□
Excessive salivation	□	□
Taste impairment	□	□
Xerostomia	□	□
Dysphagia	□	□

11. "The significance of an increased risk of oral health problems in people with diabetes is *only relevant if* the patient has been diagnosed with another diabetes related complication".

When considering this above statement, I..

Strongly disagree □$_1$ □$_2$ □$_3$ □$_4$ □$_5$ Strongly agree

12. On a scale of 1 to 5 (1 being not confident and 5 being very confident), please indicate how confident you feel in assessing oral health signs and symptoms in the diabetic patients you see?

Not confident □ $_1$ □$_2$ □$_3$ □$_4$ □$_5$ Very confident

13. On a scale of 1 to 5 (1 being not confident and 5 being very confident), please indicate how confident you feel in providing diabetes related oral health information to the patients you see?

Not confident □ 1 □2 □3 □4 □5 Very confident

14. If a client/patient with diabetes presents with signs of diabetes related complications e.g. retinopathy, nephropathy, neuropathy; how likely are you to investigate for signs and symptoms of dental problems at this consultation?

Highly unlikely □ 1 □2 □3 □4 □5 Highly likely

15. When performing complication screening tests in the diabetic patient, how often would this include oral health signs and symptoms?

- □ Each visit
- □ Quarterly
- □ Half yearly
- □ Yearly
- □ Other_____
- □ I do not routinely perform oral health assessments

16. Please indicate which of the following you undertake with your diabetic patients. (Please select all that apply)

- □ Oral health screening questions
- □ Oral health *and* diabetes risk assessment
- □ Discuss risk-related behaviours and outcomes upon oral health e.g. poor oral hygiene, smoking and glycaemic control
- □ Discuss preventative oral health care behaviour e.g. brushing, flossing and mouthwash use
- □ I recommend to the patient that they attend a dentist/periodontist appointment for assessment and care follow -up
- □ I refer to a dentist/periodontist if I perceive the need

17. In which presenting circumstances, would you investigate the oral health status of this patient? (Please select all that apply)

- □ When the patient is ill *with* known cause
- □ When the patient is ill *without* identified cause

- □ When the patient is pregnant *or* planning pregnancy
- □ Only when a specific oral health concern or complaint is identified by the patient
- □ When referred by a dentist/periodontist
- □ Other_____

18. A person with diabetes presents with a complaint of a "sore mouth" and a history of mouth ulcers. Please indicate which of the following actions you are likely to undertake at this consultation?

	Yes$_1$	**No$_2$**
a. Inspection of the hard and soft tissues in the mouth cavity	□	□
b. Inspection of the teeth	□	□
c. Note number of teeth present or missing	□	□
d. Note presence of oral infections	□	□
e. Note presence of oral lesions	□	□
f. Document oral findings and diagnosis	□	□
g. Question the patient regarding:		
i. Glycaemic control	□	□
ii. Frequency of personal dental care activity	□	□
iii. Frequency of professional dental care visits	□	□
iv. Changes taste sensation	□	□
v. Food choices in respect to flavours	□	□
vi. Use of oral medications	□	□
vii. Level of hydration	□	□
viii. Referral to dentist/periodontist	□	□
h. Other actions undertaken_____		

19. The above patient reports further symptoms in conjunction with your assessment of the oral cavity. Please indicate on a scale of 1 to 5 (1 being no concern and 5 being very concerned), the level of concern you would have, *if the patient is also identified as having* the following problems:

a. Bleeding gums when brushing:

No concern □ $_1$ □$_2$ □$_3$ □$_4$ □$_5$ Very concerned

b. Loose teeth:

No concern □ $_1$ □$_2$ □$_3$ □$_4$ □$_5$ Very concerned

c. Changes in the way the teeth fit together:

No concern □ 1 □2 □3 □4 □5 Very concerned

d. Pain when chewing:

No concern □ 1 □2 □3 □4 □5 Very concerned

e. Red, swollen or tender gums:

No concern □ 1 □2 □3 □4 □5 Very concerned

f. Noted halitosis or is informed by others of breath odour:

No concern □ 1 □2 □3 □4 □5 Very concerned

g. Tartar formation:

No concern □ 1 □2 □3 □4 □5 Very concerned

20. A patient presents complaining of a symptom of a "dry mouth". Please indicate on a scale of 1 to 5 (1 being highly unlikely and 5 being highly likely), how likely you are to suggest the following recommendations in treatment options to this patient? (Please select all that apply)

	Highly unlikely 1	**2**	**3**	**4**	**Highly Likely 5**
a. Using sugarless gum	□1	□2	□3	□4	□5
b. Using sugarless mints	□1	□2	□3	□4	□5
c. Frequent sips of water or ice chips	□1	□2	□3	□4	□5
d. Restricting caffeine/ETOH intake	□1	□2	□3	□4	□5
e. Rinsing with fluoride mouthwash	□1	□2	□3	□4	□5
f. Use of saliva substitutes	□1	□2	□3	□4	□5
g. Improving glycaemic control	□1	□2	□3	□4	□5
h. Undergoing a medication review	□1	□2	□3	□4	□5
i. Referral to GP for review	□1	□2	□3	□4	□5
j. Referral to dentist/periodontist for review	□1	□2	□3	□4	□5

21. What changes would assist you in being able to improve the oral health care in the people with diabetes you manage?

_____

_____

_____

_____

_____

_____

Thank you for your time in completing this survey.
Catherine McLaine, RN, CDE.

Appendix E: Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments.

Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments

Pilot phase question stem and/or answer options	**Adjustment made to question stem and/or answer options for final version**	**Rationale for change**
Section One: Socio-demographic questions		
"To which professional category do you belong?" With an answer option: "Accredited Practicing Dietitian".	"What is your principle profession?" Changed to read "Dietitian".	Improved clarity of question Pilot phase testing indicated that not all Dietitians may be accredited.
How many years of experience do you have *specifically* in diabetes care management?	The categories indicating the years of experience, other than less than one year and more than 25 years, were changed to five year increments	Numbered to ensure exclusivity in respondent's answers for data analysis.
"What is your current employment setting? (Please select all that apply)"	What is your primary employment setting? (Please select ONE only)".	Identified that diabetes care providers often work across several organisations/have varied or multiple roles in their place of employment. Single forced ranking to capture respondent's role where they spent the most time in diabetes care and to ensure sufficient numbers within the categories to enable the statistical t-test and ANOVA to be undertaken on the data.
Question stems containing the word 'patient'	'patient/client'	To reflect varied service delivery models

Appendix E: Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments.

Pilot phase question stem and/or answer options	**Adjustment made to question stem and/or answer options for final version**	**Rationale for change**
"With which client population do you work? (Please select all that apply)"	"What is the age group of the patients/clients with whom you work? (Please number in sequence, 1, 2, 3, where 1 indicates the patients/clients you see most. Please record a 0 if you do not see the age group)". *and* "Do you work with patients/clients who are from the following groups? (Please select all that apply)".	Improved data collection from splitting answer option into two new questions and rewording of the question stems. The numbering allocation in the answer allows for an improved data collection in each variable and data analysis which identifies frequency counts for each age group. Allows identification of the association between risk factors for diabetes and oral health complications in the diabetes type by age category.
"What is the postcode of your main position in diabetes care?"	"What is the postcode of this position?"	Rewording reflected an improved relationship to the previous question regarding the respondent's primary employment setting. Enabled comparison of frequency counts of respondents and cross tabulation analysis of knowledge and scope of practice questions with Australian state.

Appendix E: Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments.

Pilot phase question stem and/or answer options	Adjustment made to question stem and/or answer options for final version	Rationale for change
Section Two: Diabetes and oral health education questions		
"Have you ever attended an education session on diabetes and oral health complications?" with the answer options: "Yes and No".	"No, go to question 14, Yes, attended in last 5 years and Yes, attended more than 5 years ago".	Allowed the respondent to skip questions regarding education if not applicable to them. Allowed analysis of the extent and currency of the respondent's knowledge in diabetes and oral health complications.
"In what form has this education been delivered? (Please select all that apply)" with answer options: "A professional body conference session; University lecture; Industry sponsored seminar; Peer delivered in-service session; Independent learning CD-rom self instructional tools; Web-based instructional modules; Core textbooks; Journals; and Other".	Three new questions formed: "In what form was this education delivered? (Please select ONE only)" with answer options: "University lecture; A professional association conference session/seminar; Industry sponsored seminar; In-service session delivered by a member of the health care team; and Other (Please specify)". *And* "Have you undertaken any self directed learning in the area of diabetes and oral health complications?" With the answer options: "No, go to Question 15 and "Yes" *And* "Which of the following forms did you use to acquire extra knowledge? (Please select ONE only)" with answer options: "CD-rom self instructional tools; Web-based	Allowed the respondent to skip questions that were not applicable to them. To keep themed questions grouped together thus improving the flow of questioning in order to keep respondent interest. Enabled collection of data regarding formal versus self-directed education which in the analysis of the data is considered in the context of resources and enabling factors for practice.

	instructional modules; Core textbooks; Journals; All/most of the above; and Other (please identify the education form)".	
Pilot phase question stem and/or answer options	**Adjustment made to question stem and/or answer options for final version**	**Rationale for change**
"Was diabetes and oral health complications content covered during your endocrinology studies or diabetes education course?" The answer options were "Yes and No".	"Was oral health complications in diabetes covered during your professional education?" With answer options "Yes, No and Cannot recall".	Pilot testing indentified need for wording which was more inclusive of Allied Health Professional categories and/ respondents who had did not have these specific course qualifications.
"Research indicates that diabetes is known to be associated with certain oral manifestations. From *your* clinical experience and knowledge of diabetes, is there an association between diabetes and the following oral health problems?" The answer options were "Yes and No".	Addition of some 'layman's terms' for the more unusual medical terminology in the question along with the addition of the 'Don't know' answer option.	Pilot testing identified a health professional should have the option of identifying a lack of knowledge in the clinical area rather than a forced ranking of 'yes' or 'no', which may result in an inaccurate capture of the participant's level of knowledge. The concern that a health professional may not want to be identified as not knowing information that others may perceive as necessary, was considered further. A decision to identify to the within the *Participant information sheet* (Appendix 3) the statement: "Some content within the questionnaire may be unfamiliar to all members, however your responses to each question is highly valuable in the overall results of this study and are welcomed".

Appendix E: Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments.

Pilot phase question stem and/or answer options	Adjustment made to question stem and/or answer options for final version	Rationale for change
Section Three: Diabetes and oral health complication management practice questions		
On a scale of 1 to 5 (1 being not confident and 5 being very confident), please indicate how confident you feel in assessing oral health signs and symptoms in the diabetic patients you see?" *And* "On a scale of 1 to 5...how confident do you feel in providing diabetes related oral health information to the patients you see?"	Two questions combined to become one question, number 18 in the final version with two parts two parts: a) "Assessing oral health signs and symptoms in the people with diabetes you see?" and b) "Providing diabetes related oral health information to the patients/clients you see?	Improved wording and removal of excess question. The single question stem reflected the same wording for a Likert scale of confidence.
When performing complication screening tests in the diabetic patient, how often would this include oral health signs and symptoms? With answer options: "Each visit; Quarterly; Half yearly; Yearly; Other; and I do not routinely perform oral health assessments".	"When assessing/screening for complications in the person with diabetes, how often would this *include* oral health signs and symptoms?" with answer options: "Never, it is not within my scope of practice to perform diabetes and oral health assessments → if you have selected this response you have completed the survey; Each visit; Quarterly, Half yearly; Yearly, I do not routinely perform diabetes and oral health assessments; and Other (please specify)" option.	Inclusion of the wording 'Never, not within my scope of practice' enabled the respondent who does not perform diabetes and oral health complication screening to exit the survey thereby skipping the final four questions which related to the circumstances and actions undertaken in clinical practice when screening the patient/client for diabetes and oral health complications. The wording and order of the last two answer options allow identification of the respondent who may perform the ad hoc oral health assessment as part of diabetes care. The 'Other' option allowed the respondent to identify more specific or individualised information about their clinical practice.

Appendix E: Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments.

Pilot phase question stem and/or answer options	**Adjustment made to question stem and/or answer options for final version**	**Rationale for change**
"Please indicate which of the following you undertake with your diabetic patients. (Please select all that apply)" with answer options "Oral health screening questions; Oral health *and* diabetes risk assessment; Discuss risk-related behaviours and outcomes upon oral health e.g. poor oral hygiene, smoking and glycaemic control; Discuss preventative oral health care behaviour e.g. brushing, flossing and mouthwash use; I recommend to the patient that they attend a dentist/periodontist appointment for assessment and care follow-up; and I refer to a dentist/periodontist if I perceive the need".	First and second answer options reworded as 'Routine oral health screening questions' and 'Specific diabetes and oral health risk assessments'.	Allowed the respondent to more accurately identify their screening practices.

"In which presenting circumstances, would you investigate the oral health status of this patient? (Please select all that apply)", with the answer options: "When the patient is ill *with* known cause. When the patient is ill *without* identified cause; When the patient is pregnant *or* planning pregnancy; Only when a specific oral health concern or complaint is identified by the patient; When referred by a dentist/periodontist; and Other".	A single wording change from "ill" to 'hyperglycaemic' was undertaken	To identify the respondent who recognised the need for screening of oral health complications when combined with an increased risk factor of hyperglycaemia, as identified from the literature review.
Pilot phase question stem and/or answer options	**Adjustment made to question stem and/or answer options for final version**	**Rationale for change**
"The above patient reports further symptoms in conjunction with your assessment of the oral cavity. Please indicate on a scale of 1 to 5 (1 being no concern and 5 being very concerned), the level of concern you would have, *if the patient is also identified as having* the following problems: bleeding gums; loose teeth; changes in the way the teeth fit together; pain when chewing, red, swollen or tender gums; noted halitosis or is informed by others of breath odour; and tartar formation".	"The patient/client who complained of a sore mouth and a history of mouth ulcers now reports further symptoms. You conduct an assessment of the oral cavity and find the following problems...Please indicate on a scale of 1 to 5 (1 being no concern and 5 being very concerned), the level of concern you would have.	Improved wording links this question with the previous question. Improved layout of the question stem and answer options is aimed at keeping the respondent's interest and streamlining the answers.

Appendix E: Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments.

Pilot phase question stem and/or answer options	**Adjustment made to question stem and/or answer options for final version**	**Rationale for change**
"What changes would assist you in being able to improve the oral health care in the people with diabetes you manage?"	"What factors will influence your ability to *improve* the diabetes related oral health care for people that you manage? (Please select all that apply) with the answer options "None, I consider it outside my professional scope of practice; Further 'diabetes and oral health care' professional development; On line chat group; Diabetes and oral health clinical practice guidelines; 'Diabetes and oral health care' education pamphlets for patients/clients; 'Oral health care services' information pamphlets for patients/clients; Greater access to dental services; Streamlined referral processes; Medicare item provision; Multidisciplinary team care arrangements; and Other (please specify)".	The answer options were identified by the pilot phase participants and the researcher. It was determined that offering answer options would prompt the respondent to further identify individual driving forces affecting their practice in the free text field offered.

Diabetes and Oral Health Complications: Knowledge and Scope of Practice questionnaire amendments continued

Additional question s in final version	
Question Type and Number	**Rationale for inclusion**
Question 2: "Are you a credentialed member of the ADS or ADEA organisations? With answer options; "Yes; No; and Not applicable".	For respondents who cannot meet a credentialing category due to their profession type; a "Not applicable" option was offered. To capture information from members who have met the additional criteria of credentialing which for the ADEA sample members requires: A post graduate qualification in an accredited diabetes education and management course Evidence of a clinically mentored relationship with a credentialed diabetes educator, A minimum 1800hrs of clinical practice in the specialty of diabetes and satisfactory completion of practice across the key areas of professional and community involvement, continuing education, professional responsibility and accountability, and quality improvement. In the later chapter in data analysis the additional knowledge and skills possessed by a credentialed versus non-credentialed respondent in their knowledge and scope of practice in diabetes oral health complication care was considered.
Question 4: "Do you work solely in diabetes care?" with answer options "Yes; No, I work in a generalised health care area; and Other" option was provided.	This question was added to differentiate the respondents from the varied health professional groups whose work role is solely with people with diabetes in comparison with those who may see a patient population both with and without diabetes. It also identifies the health professionals who may work within educational, research or administrative roles. The options in this question provided clarity in the following question which asked the respondents to identify the 'years of experience *specifically* in the diabetes care area". A pilot participants' feedback indicated difficulty otherwise

	in be able to accurately identify length of time in diabetes care especially if their role was in a more general population of patients/clients as opposed to working specifically with people living with diabetes.
Question number	**Rationale for inclusion**
Question 8: "Do you work directly with patients/clients in your role?" with answer options "No, go to question 11, and Yes"	Allowed the respondent who did not directly provide care to skip questions that were specific to a patient/client population. This was also an attempt to maintain the respondent's interest in continuing the questionnaire.
Question 20: "In considering provision of care to people with diabetes, which health professionals do you consider has a role in the assessment and management of diabetes related oral health care?"	To identify whether the respondent believed they or others in the patient's health team had a responsibility for the diabetes and oral health complication management practices. Analysis of the answers obtained in the Likert scale items for the confidence, likelihood and concern the respondent has in their practice were cross tabulated with questions that identified a responsibility for diabetes and oral health screening, promotion and patient/client education by professional category and is discussed in the later chapters.
Question 22: "What do you consider are barriers to you being able to provide diabetes related oral health care in your practice? (Please select all that apply).	This question identifies the restraining forces for the health professional to improve diabetes and oral health care provision to people living with diabetes.
Question 22: Answer options included: "Not in my professional scope of practice; Lack of knowledge of diabetes and oral health issues; Lack of clinical practice guidelines; Lack of referral processes; Lack of access to dental services; Lack of reimbursement for management time required; Lack of time to include oral health issues in my management of diabetes; Lack of recognition of my role in diabetes and oral health education; and Other (please specify)".	The answer options were added to stimulate the respondent to reflect upon their own employment setting and clinical practices as well as the "Other" free text option for stating more individualised factors.

Appendix F: Sample initial correspondence with the ADS.

McLaine, Catherine C

From: Suzie Neylon [sneylon@racp.edu.au]
Sent: Monday, 19 January 2009 1:59 PM
To: McLaine Catherine
Subject: Re: Request for assistance from ADS

Dear Catherine

Thank you for your email. Do you have a copy of the electronic survey? I will need this to seek authorisation from the executive.

Regards

Suzie

----- Original Message -----
From: McLaine Catherine
To: sneylon@racp.edu.au
Sent: Monday, January 19, 2009 1:30 PM
Subject: Request for assistance from ADS

Mrs Catherine McLaine,
10 Umfrevilles Road,
Kaoota,
Tasmania, 7150

ADS Secretariat
Ms Suzie Neylon
Executive Officer
145 Macquarie Street
Sydney, NSW, 2000.

19th January 2009.

Dear Ms Neylon
My name is Catherine McLaine, I am enrolled within the Master of Nursing (Research) course at Curtin University of Technology in Western Australia. I am currently undertaking a study into diabetes and oral health complications, looking specifically at the Australian diabetes health care provider's knowledge and scope of practice in this area of need.
I am requesting assistance from the Australian Diabetes Society in being able to distribute to your membership an electronic questionnaire, which will which will take approximately 5 minutes to complete.
I undertake to acknowledge the support of the Society in any subsequent written reports of the survey results. I look forward to your support in this matter.
Yours Sincerely
Catherine McLaine, R.N, CDE.

Appendix G: Sample initial correspondence with the ADEA.

McLaine, Catherine C

From: Inquiries [inquiries@adea.com.au]
Sent: Monday, 19 January 2009 2:27 PM
To: McLaine Catherine
Subject: RE: request for assistance
Attachments: Distribution of Research Policy - Rev August 2011.pdf

Dear Catherine

All requests to distribute research notices and questionnaires to ADEA members should be forwarded to the ADEA National Office. Requests will be forwarded to the ADEA Research Committee for review and recommendation.

The following information must accompany an application:

☐ statement of the aim or purpose of the research or research hypothesis if applicable

☐ copy of Ethics Committee approval

☐ intended use and publication of results

☐ name of client on whose behalf the applicant is acting if not acting on their own behalf

☐ short statement regarding the significance of the research to diabetes care and the strategic objectives of ADEA

☐ outline of the study method

☐ name of organisation that granted ethics approval or Quality Management Committee or equivalent, and written documentation of that approval

☐ copy of questionnaire and accompanying explanatory letters or advertisements.

If the research notice or questionnaire is approved by the ADEA Executive, the applicant will be advised that ADEA will facilitate distribution to its members provided that:

☐ endorsement by ADEA of either the content of the questionnaire, the research project or the results is not indicated in any manner

☐ ADEA's name is not associated with the dissemination or publication of the results except with the written permission of the ADEA

☐ a copy of the final report, paper or thesis is sent to ADEA.

Kind Regards

Wendy Logan
National Office
Administrative Officer

From: McLaine Catherine [mailto:Catherine.McLaine@dhhs.tas.gov.au]
Sent: Monday, 19 January 2009 2:09 PM
To: inquiries@adea.com.au
Subject: request for assistance

Mrs Catherine McLaine,
10 Umfrevilles Road,
Kaoota,
Tasmania, 7150

Australian Diabetes Educators Association
Administrative Officer
Level 2B, 27 Mulley Street
Holder, ACT, 2611

19th January 2009.

Dear Ms Logon,

My name is Catherine McLaine, I am enrolled within the Master of Nursing (Research) course at Curtin University of Technology in Western Australia. I am currently undertaking a study into diabetes and oral health complications, looking specifically at the Australian diabetes health care provider's knowledge and scope of practice in this area of need.

I request assistance from the Australian Diabetes Educators Association in being able to distribute to the membership an electronic questionnaire which will which will take approximately 5 minutes to complete. I will acknowledge the support of the ADEA in any subsequent written reports of the survey results.

I look forward to your support in this matter.

Yours Sincerely
Catherine McLaine, R.N., CDE.

Appendix H: Sample Curtin University Human Research Ethics Committee approval 2009.

memorandum

Curtin
University of Technology

To	Ms Catherine McLaine
From	Associate Professor Dianne Wynaden
Subject	Protocol Approval SON&M 9-2009
Date	19th May 2009
Copy	Dr Paul Snider

Office of Research and Development

Human Research Ethics Committee

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for your "Form C Application for Approval of Research with Minimal Risk (Ethical Requirements)" for the project titled *"DIABETES AND ORAL HEALTH COMPLICATIONS: AUSTRALIAN DIABETES HEALTH CARE PROFESSIONALS' KNOWLEDGE AND SCOPE OF PRACTICE"*. On behalf of the Human Research Ethics Committee I am authorised to inform you that the project is approved.

Approval of this project is for a period of twelve months «19th May 2009 to «19th May 2010.

If at any time during the twelve months changes/amendments occur, or if a serious or unexpected adverse event occurs, please advise me immediately. The approval number for your project is **«SON&M 9-2009**. *Please quote this number in any future correspondence.*

Associate Professor Dianne Wynaden
Low Risk Coordinator
School of Nursing and Midwifery

Please Note: The following standard statement must be included in the information sheet to participants:
This study has been approved by the Curtin University Human Research Ethics Committee. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784.

Appendix I: Sample Curtin University Human Research Ethics Committee approval 2010.

memorandum

Curtin
University of Technology

To	Catherine McLaine
From	Associate Professor Dianne Wynaden
Subject	Protocol Approval **SON&M 9-2009**
Date	6th May 2010
Copy	

Office of Research and Development

Human Research Ethics Committee

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for your renewal of "Form C application for your Research with Minimal Risk (Ethical Requirements)" project titled **"Diabetes and oral health complications: Australian diabetes health care professionals' knowledge and scope of practice."** On behalf of the Human Research Ethics Committee I am authorised to inform you that the renewal of ethics for the project is approved.

Approval of this project is for a period of twelve months from **6th May 2010** to **6th May 2011.** If at any time during the twelve months you have any amendments or if a serious or unexpected adverse event occurs, please advise me immediately. The approval number for your project is **SON&M 9-2009.** *Please quote this number in any future correspondence.*

Associate Professor Dianne Wynaden
Low Risk Coordinator
School of Nursing and Midwifery

Please Note: The following standard statement must be included in the information sheet to participants: *This study has been approved by the Curtin University Human Research Ethics Committee. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784.*

Appendix J: Sample Study invitation to ADEA and ADS members (version one).

Dear diabetes health care provider.

My name is Catherine McLaine; I am a Credentialed Diabetes Educator and enrolled in a Master of Science at Curtin University of Technology in Western Australia. As part of this course I am currently undertaking a study into diabetes and oral health complications, looking specifically at the Australian diabetes health care professionals' knowledge and scope of practice in this area of need.

The Background to the study:
There is growing acceptance within the dental and medical health professions that diabetes is associated with increased occurrence, extent and severity of oral health problems. International studies have shown that people with diabetes are at increased risk of more severe periodontal disease compared with those without diabetes. The research indicates a two-way connection between diabetes and periodontal disease, proposing that not only is the diabetic person more prone to periodontal disease, but the presence of periodontal disease affects control of blood glucose. The risk is independent of whether the diabetes is Type 1 or Type 2. The extent of the risk however relates to the duration and control of the diabetes with the likelihood of the periodontal disease increasing markedly when diabetes is poorly controlled. Management of oral health problems associated with diabetes within the Australian health care system appears to be neither well identified nor implemented. Currently the promotion of oral health issues in diabetes by health care providers in clinical practice and management appears to be insufficient, given the magnitude of the problems that can arise. With the significant increase in the incidence and prevalence of diabetes mellitus and further projected increases with the associated health cost burden, Australia's health care system and health care providers cannot continue to ignore this important aspect of diabetes care, which up to the present has been largely overlooked.

I therefore wish to extend an invitation to you to participate in this study by completing an on-line questionnaire. You may access the *PARTICIPANT INFORMATION SHEET* to find out more about the study as well as complete the survey at the following link:

http://www.surveymonkey.com/s/CT8WC29

Please take the time to complete this survey; the findings may lead to useful clinical protocols to guide oral health care for people with diabetes. Your opportunity to participate will close at Midnight on June 6th, 2010.

Thank you for your valued time and feedback

Catherine McLaine RN, CDE

Appendix K: Sample Participant Information Sheet (version one).

PARTICIPANT INFORMATION SHEET

Research study title

"Diabetes and oral health complications: Australian diabetes health care professionals' knowledge and scope of practice."

There is growing acceptance within the dental and medical health professions that diabetes is associated with increased occurrence, extent and severity of oral health problems. International studies have shown that people with diabetes are at increased risk of more severe periodontal disease compared with those without diabetes. The research indicates a two-way connection between diabetes and periodontal disease, proposing that not only is the diabetic person more prone to periodontal disease, but the presence of periodontal disease affects control of blood glucose. The risk is independent of whether the diabetes is Type 1 or Type 2. The extent of the risk however relates to the duration and control of the diabetes with the likelihood of the periodontal disease increasing markedly when diabetes is poorly controlled.

Management of oral health problems associated with diabetes within the Australian health care system appears to be neither well identified nor implemented. Currently the promotion of oral health issues in diabetes by health care providers in clinical practice and management appears to be insufficient, given the magnitude of the problems that can arise. With the significant increase in the incidence and prevalence of diabetes mellitus and further projected increases with the associated health cost burden, Australia's health care system and health care providers cannot continue to ignore this important aspect of diabetes care, which up to the present has been largely overlooked.

Aims of the study:
The purpose of this study is to ascertain the current level of knowledge and scope of practice amongst Australian diabetes health care providers in the prevention, promotion and management of diabetes related oral health complications in the varied patient population that they manage.

Participation in the study:
You are invited to participate in this study through completion of an online electronic questionnaire, which may take up to 30 minutes to complete.

The purpose of the questionnaire is:

1. To measure Australian diabetes health care professional's level of knowledge of oral health issues which impact upon the person with diabetes.

2. To describe the diabetes health care professional's scope of practice regarding intervention, health promotion and care management of oral health issues in persons with diabetes.

3. To identify the restraining and driving forces that influences the provision of oral health care prevention and intervention for people with diabetes.

Appendix K: Sample Participant Information Sheet (version one).

Your consent:

- Participation is voluntary**;** participants will not be coerced into participation through inducements nor payments.
- Completion of the electronic questionnaire will be considered implied consent.
- Personal identification details will not be required and the information obtained will remain anonymous.
- The study is considered to be minimal risk; no harm will be caused to any participants.

Results of the Study:
The results achieved from the questionnaire will be analysed as part of a Curtin University of Technology, Masters of Nursing (Research) thesis and will be made available upon completion to the Australian Diabetes Society and Australian Diabetes Educators Association. It is anticipated that the outcome of the questionnaire may provide a level of evidence to support clinical practice guideline development and an improved level of diabetes care management in the future.

Complaints:
This study has been approved by the Curtin University of Technology Human Research Ethics Committee (Approval number -pending).

If needed, verification of approval can be obtained either by writing to:

Curtin University Human Research
Ethics Committee
c/- Office of Research and Development
Curtin University of Technology
GPO Box U1987
Perth, WA 6845
or by telephoning 08 9266 2784
or emailing hrec@curtin.edu.au

Contact Details of Researcher.
If you require further information or if you have any concerns regarding this study, the Masters student or Study Supervisor may be contacted.

Masters Student

Mrs Catherine McLaine, RN, CDE
Diabetes Centre,
Royal Hobart Hospital,
48 Liverpool Street,
Hobart,
Tasmania, 7000
Australia.
Tel (03) 62 228788
Email: catherine.mclaine@dhhs.tas.gov.au

Study Supervisor

Mrs Karen Glaister,
Director, Teaching and Learning
School of Nursing and Midwifery
Faculty of Health Sciences
Curtin University of Technology,
GPO Box U1987,
Perth, WA, 6845
Tel (08) 9266 2214
Fax (08) 9266 2959
Email: k.glaister@curtin.edu.au

Appendix L: Sample Study invitation to ADEA and ADS members (version two).

Dear diabetes health care provider.

My name is Catherine McLaine; I am a Credentialed Diabetes Educator and enrolled in a Master of Science at Curtin University of Technology in Western Australia. As part of this course I am currently undertaking a study into diabetes and oral health complications, looking specifically at the Australian diabetes health care providers' knowledge and scope of practice in this area of need.

I wish to extend an invitation to you to participate in this study by completing an on-line questionnaire.

Please read the attached *PARTICIPANT INFORMATION SHEET* to find out more about the study. You may access the survey at the following link:

http://www.surveymonkey.com/s/CT8WC29

Please take the time to complete this survey; the findings may lead to useful clinical protocols to guide oral health care for people with diabetes. Your opportunity to participate will close at Midnight on May 31st, 2010.

Thank you for your valued time and feedback

Catherine McLaine RN, CDE

Appendix M: Sample participants Information Sheet (Version two on SurveyMonkey).

Participant Information Sheet

Aims of the study:
The purpose of this study is to ascertain the current level of knowledge and scope of practice amongst Australian diabetes health care providers in the prevention, promotion and management of diabetes related oral health complications in the varied patient population that they manage. It is acknowledged that some content within the questionnaire may be unfamiliar to all members, however your responses to each question is highly valuable in the overall results of this study and are welcomed.

Participation in the study:
You are invited to participate in this study through completion of the following questionnaire, which may take up to 20 minutes to complete.

The purpose of the questionnaire is:
1. To measure Australian diabetes health care professional's level of knowledge of oral health issues which impact upon the person with diabetes.
2. To describe the diabetes health care professional's scope of practice regarding intervention, health promotion and care management of oral health issues in persons with diabetes.
3. To identify the restraining and driving forces that influences the provision of oral health care prevention and intervention for people with diabetes.

Your consent:
- Participation is voluntary; participants will not be coerced into participation through inducements nor payments.
- Completion of the electronic questionnaire will be considered implied consent.
- Personal identification details will not be required and the information obtained will remain anonymous.
- The study is considered to be minimal risk; no harm will be caused to any participants.

Results of the Study:
The results achieved from the questionnaire will be analysed as part of a Curtin University of Technology, Masters of Science thesis and will be made available upon completion to the Australian Diabetes Society and Australian Diabetes Educators Association. It is anticipated that the outcome of the questionnaire may provide a level of evidence to support clinical practice guideline development and an improved level of diabetes care management in the future.

Complaints:
This study has been approved by the Curtin University of Technology Human Research Ethics Committee (Approval number – SON&M 9/2009).

If needed, verification of approval can be obtained either by writing to:
Curtin University Human Research Ethics Committee
c/- Office of Research and Development
Curtin University of Technology
GPO Box U1987
Perth, WA 6845
or by telephoning 08 9266 2784
or emailing hrec@curtin.edu.au

Appendix M: Sample participants Information Sheet (Version two on SurveyMonkey).

Contact Details of Researcher:
If you require further information or if you have any concerns regarding this study, the Masters student or Study Supervisor may be contacted.

Masters Student:
Catherine McLaine, RN, CDE,
Diabetes Centre,
Royal Hobart Hospital
48 Liverpool Street
Hobart, Tas 7000
Ph: 03 62228788
Email: catherine.mclaine@dhhs.tas.gov.au

Study Supervisor:
Karen Glaister,
Director, Teaching and Learning
School of Nursing and Midwifery,
Faculty of Health Sciences,
Curtin University of Technology,
GPO Box U1987,
Perth, WA, 6845
Australia.
Tel (08) 9266 2201
Fax (08) 9266 2959
Email: k.glaister@curtin.edu.au

Please click 'Next' to start the questionnaire.

Appendix N: Sample ADS newsletter notice of extension date of study invitation.

Diabetes & Oral Health Complications Study

This is your final opportunity to participate in a 'Diabetes & Oral Health Complications Study' by completing an on-line questionnaire. Catherine McLaine RN, CDE Master of Science Student from

Curtin University of Technology, WA, is currently undertaking a study into diabetes and oral health complications, looking specifically at the Australian diabetes health care provider's knowledge and scope of practice in this area of need. You may access the **PARTICIPANT INFORMATION SHEET** to find out more about the study as well as complete the survey at the following link:

http://www.surveymonkey.com/s/CT8WC29

Please take the time to complete this survey; the findings may lead to useful clinical protocols to guide oral health care for people with diabetes. Your opportunity to participate will close at **Midnight on Sunday 22nd August, 2010.**

Appendix O: Description statistics of the participants' identification of 'Other' employment settings.

Participants' description of 'Other' employment setting

Type of Setting	Frequency	Percent of N[a]
Aboriginal health Service	2	1.3
Centre covers community and public hospital	1	0.7
Correctional health facility	1	0.7
Diabetes Australia	1	0.7
Diabetes clinical trials and Private practice	1	0.7
Diabetes organisation	2	1.3
District Nursing Service	1	0.7
Division of General Practice	1	0.7
Non-Government Organisation, Not-for-profit organisation and Private practice one day per week	1	0.7
Non Government Organisation	1	0.7
Not-for-Profit Organisation	1	0.7
Private mobile practice within Adelaide city and metropolitan areas	1	0.7
Remote Aboriginal communities	1	0.7
Remote area health service	1	0.7
Residential Aged Care	1	0.7
Shared partnership between Queensland Health and Rural Health Queensland.	1	0.7
University	1	0.7
Total	19	12.4

Note. [a]N = Total number 153 participants.

Appendix P: Description statistics of the participants' identification of 'Other' forms of self-directed educational resources used to gain diabetes and oral health knowledge

Description statistics of the participants' identification of 'Other' forms of self-directed educational resources used to gain diabetes and oral health knowledge

Education form	Frequency	Percent
Audio conferencing series	1	0.65
Both texts and journals	1	0.65
Diabetes Australia resource information website	1	0.65
Discussions with dentist and oral hygienist	1	0.65
Information from Dental Association	1	0.65
Lecture [a]	1	0.65
Total	6	3.90

Note. [a] No further explanation provided by respondent

Appendix Q: Participants' identification of 'Other' timeframes in initiating diabetes and oral health complication assessment and screening in patients.

Participants' identification of 'Other' timeframes in initiating diabetes and oral health complication assessment and screening in patients

Participants statements (Participants identification number)
Within existing service delivery:
"At diagnosis and annually in non-complex Type 2. As part of annual cycle of care for paediatric and transitioning adolescent and non- complex Type 1. Each trimester during pregnancy, and biannually in complex Type 2." (152)
"At the initial visit."(123)
"During initial visit, assess and provide education about oral complications." (17)
"On admission of new client, ask about most recent dental review and any current dental issues." (28)
"Initial assessment, education groups, first review appointment and then annual review - unless further review required."(54)
"Each assessment, suggest a yearly dental review as part of the annual cycle of care." (85)
"During the education process, oral health is highlighted as an important part of the clients self-management of their diabetes." (66)
"Include dental care within education session, suggest dental review if BGLs persistently elevated." (146)
"This will vary from person to person. As part of the self-management education." (118)
"When giving Living with Diabetes talks, advise clients to use one or two of their five health professional annual Medicare allowable visits through the GP chronic disease care plan for dental checkups." (75)
"Briefly when discussing complications." (23)
"Varies on patient needs - whenever talking about potential of DM complications - oral/dental health is discussed as part of that education." (14)
Investigation of signs and symptom
"Do not routinely include it. To identify the cause of hyperglycaemia, will then ask about the oral health care, admittedly this is still infrequent." (135)
"Oral health assessments are undertaken when problems are observed e.g. halitosis." (92)
"Sporadically, if dental issues affect eating." (89)
"When dental care issues or related issues are raised by client." (60)
Lack of service delivery:
"Currently not included in the complication assessment tool used." (13)
"Currently oral issues not routinely discussed but are now to be included on assessment form therefore attended on referral to service and annual review." (127)

Appendix R: Participants' identification of 'Other' presenting circumstances for investigation of patients' oral health status.

Participants' reasons for investigation of patients' oral health status (Participants' identification number)

Existing service delivery models:

- *"As part of an annual Team Care Arrangement referral process." (56)*
- *"At diagnosis and review." (143)*
- *"On admission of new clients." (28)*
- *"When newly referred to service, on their second visit or, if they have any complaints about their oral health." (145)*
- *"When someone is newly diagnosed with diabetes, would go through education but if not, would only discuss if it came up as part of counselling." (133)*
- *"With new patients, as part of the long term complications awareness." (92)*
- *"Clients are referred to our Centre and as part of the education program for all clients whether newly diagnosed, GDM or long term diabetics, 'touching' on oral health is part of the education program." (66)*
- *"As part of the educational/assessment visits." (50)*
- *"I discuss and look in the mouth of every patient at least twice a year." (8)*
- *"Discussed at each review and additional discussion in-between, if client expresses it is a problem e.g. gums start bleeding or report tender areas." (98)*
- *"Only during annual diabetes review." (137)*
- *"Education topic staying healthy - preventative management includes discussion of oral hygiene/dental reviews. I recommend minimum of annual review with dentist and referral back to GP if requiring Medicare Dental Health plan to assist access. Discuss risk of gum recession/bone infection/cardiac risk and linkage." (14)*
- *"I have learnt in my career early on, to look at the mouth and gums. With the right foods, if the gums and teeth are playing up then their diabetes will play up." (107)*
- *"Each person with diabetes, irrespective of glycaemic control or complications or if patient expressed concern." (45)*
- *"I ask about teeth as part of the routine assessment, but I have just realised I do not talk about gum disease as such." (63)*
- *"General discussion of issues, but not investigated." (37)*

Identification of oral health signs and symptoms*:*

- *"When I can see their teeth are in terrible condition during a conversation. When they ask about soft drinks." (89)*
- *"When I see bad teeth, I ask when they last had a dental check." (85)*
- *"When poor dental health is disclosed and client has not followed up with a dentist." (54)*
- *"When the patient identifies issues with their ability to eat certain foods or other symptoms related to their teeth and gums." (141)*
- *"If fever or any oral symptoms in diabetes of any cause." (48)*

Appendix R: Participants' identification of 'Other' presenting circumstances for investigation of patients' oral health status.

Participants' reasons for investigation of patients' oral health status (Participants' identification number) continuation.

Co-existing medical conditions:

"*When there is known cardiovascular disease." (130)*

"*Pre-surgery especially cardiac or osteo-surgical procedures." (73)*

"*Obviously need to think about it in relation to all cases of hyperglycaemia, gastroparesis and gastric reflux." (152)*

"*Those clients who take liquid meal replacements for weight loss."* (41)

Lack of service delivery:

"*It should probably be in all conditions mentioned but not in my usual role." (110)*

Appendix S: Participants' identification of 'Other' actions undertaken in the investigation of a patients' oral health complaints.

Participants' identification of 'Other' actions undertaken in the investigation of a patients' oral health complaints (Participants' identification number)

Assessment:

"Ask about therapies/medications already tried by the patient to resolve the condition." (155)

"Ask whether it has been discussed and assessed by GP."(28)

"Assess if there is any dietary restrictions or food allergies/potential increase in hypos/medication compliance and query if any new medications. Referral to GP for assessment-medication requirement/ensure communication with GP of this clinical information." (14)

"Check if client is a smoker." (101)

"Document oral findings in notes, but not give a diagnosis."(58)

"Question patient about their ability to chew raw foods, dry mouth symptoms, history of bulimia or induced vomiting." (89)

"Question when last visit to GP and dentist in regard to oral problems." (59)

Education:

"Give the client a Diabetes Australia fact sheet on dental care." (141)

Further management:

"Prescribe antibiotics if needed, review insulin/medication doses and consider salivary replacement therapies." (8)

"Advise client to attend a Dentist. No Periodontist available except in Melbourne, which is a 2-3 hour drive away." (127)

"Advise follow up with GP and Dentist." (73)

"I would recommend to the patient that they seek dental care." (87)

"If the problem is acute I would refer them to their GP for medical assessment. I would not do a detailed oral inspection/assessment but refer on to a Dentist/GP for this assessment and management." (92)

"Recommend that they see their GP and a Dentist."(85)

"Recommend they see a Dentist/relevant specialist. I would recommend they visit the GP." (110)

"Recommend visit to GP if infection, and if they are unable to afford or receive timely access to a Dentist." (129)

"Refer back to GP for assessment and treatment as required. Clients are provided with a leaflet on diabetes and oral health at initial consultation also." (98)

"Refer to GP for review". (149)

"Referral to GP." (27;31;141)

"Referral to GP if infection noted to commence antibiotics."(55)

"There is not a referral pathway in my area to refer to a Dentist or Periodontist; therefore I would involve the GP in getting the referral done especially if the client has financial constraints."(66)

Appendix T: Participants' identification of individual health professionals who have a responsibility for diabetes and oral health management.

Participants' identification of individual health professionals who have a responsibility for diabetes and oral health management.	
Health professional type	Frequency
Dental professionals	
Dentist	111
Periodontist	17
Dental hygienist	16
Orthodontist	3
Dental technician,	2
Dental therapist	2
Dental nurse	1
Total	152
Primary care setting	
GP	69
Practice nurse	7
Nurse	4
Community nurse	2
Health worker	2
Aboriginal health worker	1
Primary care staff	1
Total	86
Diabetes Health Professionals	
Diabetes Educator	75
Endocrinologist	54
Diabetes Nurse Practitioner	1
Total	130
Allied Health professionals	
Dietitian	27
Podiatrist	2
All Allied Health Professionals	2
Physiotherapist	1
Psychologist	1
Speech pathologist	1
Total	34
Other Health Professionals	
Pharmacist	5
All health care providers	3
All health professionals (no category)	1
All health care team	1
Ophthalmologist	1
Optometrist	1
Oral surgeon	1
Other medical specialists	1
Paediatrician	1
Total	15

Appendix U: Participants' identification of 'Other' influencing factors which improve management of diabetes and oral health complications.

Participants' identification of 'Other' influencing factors which improve management of diabetes and oral health complications.

Participants' statements (participants identification number)
Service delivery:
"*Medicare dental items. Include dental assessment in multidisciplinary paediatric transition clinics with service provision from State dental service." (11)*
"*Decreased public dental service waiting times. Greater awareness of Medicare funded dental services." (28)*
"*Medicare dental items." (33)*
"*Greater access to affordable and culturally appropriate dental services. Medicare dental services with a bulk bill facility for low income people." (126)*
"*Dental access for all clients." (53)*
"*Ease of access to public dental services, prioritised treatment and care expedited listing." (123)*
"*Prioritising patients on the local public health waiting list." (92)*
"*Linkage to dental services to enable prompt triage especially if problems identified or poor glycaemic control." (145).*
"*Better communication from Dentist after referral." (103)*
"*Care through private health funds." (106)*
Scope of practice:
"*Screening tools which indicate referral is necessary." (152)*
"*Discuss smoking cessation and options for quitting." (101)*

Appendix V: Participants' identification of 'Other' barriers to the management of diabetes and oral health complaints.

Participants' identification of 'Other' barriers to the management of diabetes and oral health complications.

Participants' statements (Participants identification number)
Service delivery:
"*Ability to access dental care. Lack of knowledge regarding access to Medicare dental services, need for a GP Care plan prior to achieve this." (22)*
"*Other health care providers including GPs being unaware of Medicare funded dental processes, inadequate public dental services, expensive dental care for those that don't qualify for public or Medicare dental services and it not being recognised as a priority by the clients and some health professionals." (28)*
"*Not knowing the systems and referral process for dental services." (107)*
"*Waiting times to be seen at Public Dentist are currently 2-3 years." (137)*
"*Two years waiting time at the community dental health service for most clients." (145)*
"*Access to timely appointments at the public dental service. There is a 5 month wait list currently." (123)*
"*Lack of access to affordable dental services. Need to be covered by Medicare similar to GP services and have a bulk bill facility for low income people." (126)*
"*Absent services for those of low income." (68)*
"*Cost to patient, no rebate available, long waiting list for public services." (129)*
"*Communication from Dentist after referral." (103)*
Educational resources:
"*Lack of educational resources." (11)*
"*Need clinical guidelines and more resources e.g. patient information pamphlets." (92)*
Scope of practice:
"*Lack of knowledge about which oral problems are diabetes related. Believe it is outside my scope of practice to physically examine the oral cavity." (89)*
"*I do not have appropriate equipment to check in the mouth." (118)*
"*Not fully into consciousness."(152)*
"*Prefer dental specialist in the area to look at teeth." (33)*
Patient education:
"*Unless there is pain or discomfort, the patients' lack of understanding of the importance or oral care can be a barrier." (86)*

Appendix W: Descriptive statistics for scale item reliability analysis

Descriptive Statistics for Scale Item Reliability Analysis

Scale items Question number Question label	No of items	No of cases	Cronbach's alpha	Mean	SD	Corrected item-Total correlation (Pearson correlation coefficient)
Scale element 1: Management of patient population	12	150	0.485	7.65	2.788	
Question 9: What is the age group of the patients/clients with whom you work?						
Paediatrics				0.95	1.325	0.202
Adolescents				1.55	0.901	0.408
Adults				1.04	0.325	-0.035
Question 10: Do you work with patients/clients who are from the following groups?				.		
Pregnant women				0.68	0.468	0.517
Disabled patients				0.71	0.454	0.423
Aboriginal and Torres Strait Islander people				0.63	0.485	0.380
Patients from culturally and linguistically diverse backgrounds				0.76	0.429	0.200
Patients living within residential aged care facilities				0.53	0.501	0.197
Patients within secure facilities				0.27	0.447	-0.025
Patients within rural and remote communities				0.43	0.496	0.170
No, I don't work with patients from these groups				0.03	0.180	-0.316
'Other'				0.07	0.262	-0.059

Appendix W: Descriptive statistics for scale item reliability analysis

Continuation: Descriptive Statistics for Scale Item Reliability Analysis

Scale items Question number Question label	No of items	No of cases	Cronbach's alpha	Mean	SD	Corrected item-Total correlation (Pearson correlation coefficient)
Scale element 2: Diabetes and oral health complications knowledge	5	145	0.383	7.63	3.323	
Question 11: Was oral health complications in diabetes covered during your professional education?				1.92	0.800	-0.239
Question 12: Have you ever attended an education session on diabetes and oral health complications?				1.64	0.653	0.349
Question 13: In what form was this education delivered**?**				1.31	1.382	0.314
Question 14: Have you undertaken any self directed learning in the area of diabetes and oral health complications?				1.33	0.472	0.716
Question 15: Which of the following forms did you use to acquire extra knowledge?				1.43	2.111	0.281

Appendix W: Descriptive statistics for scale item reliability analysis

Continuation: Descriptive Statistics for Scale Item Reliability Analysis

Scale items Question number Question label	No of items	No of cases	Cronbach's alpha	Mean	SD	Corrected item-Total correlation (Pearson correlation coefficient)
Question 16: From *your* clinical experience and knowledge of diabetes, is there an *association* between diabetes and the following oral health problems?	14	147	0.714	27.12	5.089	
Glossodynia and stomatopyrosis				2.58	0.802	0.267
Candidiasis				1.37	0.768	0.296
Dental caries				1.27	0.645	0.329
Gingivitis				1.10	0.434	0.396
Mouth ulcers				1.59	0.898	0.410
Lichen planus				2.57	0.802	0.315
Oral neurosensory dysesthesia				2.48	0.871	0.365
Oral cancerous lesions*				2.62	0.601	0.404
Periodontitis				1.29	0.692	0.318
Excessive salivation*				2.50	0.696	0.363
Taste impairment				2.13	0.938	0.419
Xerostomia				1.53	0.870	0.317
Dysphagia*				2.31	0.775	0.355
Question 17: Significance of increased risk of oral health complication relevant in patient with another diabetes complication.	1	113		1.80	1.059	0.173

*Note: * denotes false oral conditions*

Appendix W: Descriptive statistics for scale item reliability analysis

Continuation: Descriptive Statistics for Scale Item Reliability Analysis

Scale item Question number Question label	No of items	No of cases	Cronbach's alpha	Mean	SD	Corrected item-Total correlation (Pearson correlation coefficient)
Scale element 3: Scope of practice in diabetes oral health complication management		113	0.779	101.96	12.067	
Question 26: Likelihood to investigate oral signs and symptoms	14	113	0.816	18.85	3.235	0.562
Inspection of the hard and soft tissues in the mouth cavity				1.42	0.497	0.539
Inspection of the teeth				1.49	0.502	0.444
Note number of teeth present or missing				1.57	0.498	0.586
Note presence of oral infections				1.20	0.404	0.649
Note presence of oral lesions				1.24	0.428	0.624
Document oral findings and diagnosis				1.35	0.478	0.317
Question the patient regarding glycaemic control				1.07	0.258	0.374
Question the patient regarding Frequency of personal dental care activity				1.21	0.411	0.374
Question the patient regarding frequency of professional dental care visits				1.09	0.285	0.262
Question the patient regarding recent changes in taste sensation				1.74	0.439	0.298
Question the patient regarding recent changes to food choices in respect to flavours				1.76	0.428	0.343
Question the patient regarding oral medications intake				1.31	0.464	0.518
Question the patient regarding level of hydration				1.27	0.448	0.347
Question the patient regarding referral to dentist/periodontist				1.12	0.331	0.248

Appendix W: Descriptive statistics for scale item reliability analysis

Continuation: Descriptive Statistics for Scale Item Reliability Analysis

Scale items Question number Question label	No of items	No of cases	Cronbach's alpha	Mean	SD	Corrected item-Total correlation (Pearson correlation coefficient)
Question 27: Levels of concern at the presenting circumstances	7	113	0.872	28.69	4.837	
Bleeding gums when brushing				3.97	0.949	0.677
Loose teeth				4.31	0.917	0.679
Changes in the way teeth fit together				3.90	1.110	0.629
Pain when chewing				4.36	0.768	0.702
Red, swollen or tender gums				4.53	0.682	0.649
Noted halitosis or told by others of breath odour				4.13	0.881	0.636
Tartar formation				3.48	1.053	0.646
Question 28: Likelihood to recommend treatment	11	113	0.813	35.73	8.150	
To use sugarless gum				2.86	1.445	0.543
To use sugarless mints				2.37	1.344	0.533
To take frequent sips of water or ice chips				3.63	1.241	0.508
To restrict caffeine intake				2.50	1.296	0.617
To restrict alcohol intake				2.80	1.304	0.470
To rinse with fluoride mouthwashes				2.32	1.248	0.579
To use saliva substitutes				2.70	1.457	0.456
To improve glycaemic control				4.28	1.138	0.452
To undergo a medication review				3.88	1.148	0.373
Referral to the GP for review				4.22	0.961	0.289
Referral to dentist/periodontist for review				4.17	1.141	0.396

Appendix W: Descriptive statistics for scale item reliability analysis

Continuation: Descriptive Statistics for Scale Item Reliability Analysis

Scale item Question number Question label	No of items	No of cases	Cronbach's alpha	Mean	SD	Corrected item-Total correlation (Pearson correlation coefficient)
Question 21: What factors will influence your ability to *improve* the diabetes related oral health care for people that you manage?	10					
None, I consider it outside my professional scope of practice				0.03	0.178	-0.165
Further 'diabetes and oral health care' professional development				0.76	0.426	0.472
On line chat group				0.05	0.223	0.200
Diabetes and oral health clinical practice guidelines				0.79	0.408	0.550
'Diabetes and oral health care" education pamphlets for patients/clients				0.86	0.352	0.611
'Oral Health Care Services' information pamphlets for patients/clients				0.66	0.475	0.478
Greater access to dental services				0.73	0.448	0.540
Streamlined referral processes				0.54	0.500	0.545
Medicare item provision				0.62	0.487	0.599
Multidisciplinary team care arrangements				0.58	0.495	0.525
'Other' factors				0.08	0.270	0.112

Appendix W: Descriptive statistics for scale item reliability analysis

Continuation: Descriptive Statistics for Scale Item Reliability Analysis

Scale item Question number Question label	No of items	No of cases	Cronbach's alpha	Mean	SD	Corrected item-Total correlation (Pearson correlation coefficient)
Question 22: What do you consider are barriers to you being able to provide diabetes related oral health care in your practice?	10					
Not in my professional scope of practice				0.80	0.280	0.024
Lack of knowledge of diabetes and oral health issues				0.53	0.501	0.215
Lack of clinical practice guidelines				0.56	0.499	0.405
Lack of referral processes				0.35	0.477	0.486
Lack of access to dental services				0.59	0.493	0.471
Lack of reimbursement for management time required				0.19	0.393	0.251
Lack of time to include oral health issues in my management of diabetes				0.33	0.473	0.365
Lack of recognition of my role in diabetes and oral health education				0.25	0.437	0.269
'Other' factors				0.11	0.315	-0.017